SURVEY OF BLOWOUT PREVENTER (BOP) MAINTENANCE, INSPECTION, AND TEST (MIT) ACTIVITIES AND MIT MANAGEMENT SYSTEMS FOR THE BUREAU OF SAFETY AND ENVIRONMENTAL ENFORCEMENT

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SUMMARY

At the operational stage of an asset's life cycle, asset maintenance and reliability practices are mostly comprised of (1) maintenance, inspection, and test (MIT) activities (i.e., proactive maintenance) and (2) maintenance and reliability management systems. In regards to this project, this report contains a study of these activities and represents one portion of deliverable F associated with Tasks 6.1.1, 6.1.2 and 6.1.3, as outlined in the contract.

The objectives of this report are to identify (1) key MIT activities and (2) some of the key maintenance and reliability management system practices impacting Blowout Preventer (BOP) reliability performance.

This report summarizes the MIT activities (and their associated frequencies) (1) contained in applicable, worldwide regulations, and industry standards and recommended practices and (2) included in Industry Participant (IP) MIT plans for BOPs operating in the Gulf of Mexico (GoM). In addition, the report provides the results from reliability and maintenance management system survey. Finally, the report provides a comparison of the MIT activities and practices and BOP performance.

Section 2 outlines and compares the MIT activities identified in applicable BOP regulations and industry standards and recommended practices. This section identifies the MIT activities and associated frequencies included in the reviewed regulations and industry standards and recommended practices. This effort included a review of the following regulations and industry standards and recommended practices:

- *Blowout Prevention in California: Equipment Selection and Testing, Tenth Edition,* California Department of Conservation, Division of Oil, Gas, and Geothermal Resources
- *Consolidated Newfoundland and Labrador Regulation 1150/96, Petroleum Drilling Regulations under the Petroleum and Natural Gas Act,* St, John's, Newfoundland, and Labrador, Canada.
- *Drilling Blowout Prevention Requirements and Procedures,* Directive 36, Alberta Energy and Utilities Board.
- *Guideline for Certification of Blow-Out Preventers,* Edition 2011, GL Noble Denton.
- *Guidelines Regarding the Facilities Regulation*, Petroleum Safety Authority Norway, 20.12.2007
- *Oil and Gas and Sulphur Operations in the Outer Continental Shelf*, Code of Federal Regulations (CFR), Part 250.

- *Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells*, Third Edition, American Petroleum Institute (API) Recommended Practice (RP) 53. *Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells*, Fourth Edition, API RP 53.
- *Recommended Practice for Well Control Operations*, Second Edition, API RP 59.
- *Well Integrity in Drilling and Well Operations*, Rev.3, Norsok Standard D-10.
- *Specification for Choke and Kill Systems*, First Edition, API Specification 16C.
- *Specification for Drilling Well Control Equipment and Control Systems for Diverter Equipment,* API Specification 16D.
- *Specification for Drill-through Equipment*, Third Edition, API Specification 16A.
- *Specification for Wellhead and Christmas Tree Equipment,* Nineteenth Edition, ANSI/API Specification 6A.

Section 3 outlines the survey of the current MIT activities included in drilling contractors' MIT plans and original equipment manufacturers' (OEMs) installation, operations, and maintenance (IOM) manuals. The effort resulted in the compilation of typical MIT activities and associated frequencies employed to maintain BOPs operating in the GoM. This survey lists more than 300 BOP MIT activities. Appendix B of this report contains the complete survey results.

Section 4 of this report outlines the MIT reliability and maintenance management system survey approach and summarizes its results. The survey inquired about MIT management system practices in six key areas: Failure Elimination, Computerized Maintenance Management System, Maintenance Management Practices, Preventive Maintenance (PM) Program, Written Instructions, and Training. The results indicated many good practices are in place and noted some improvement areas for each area reviewed. The survey respondents consisted of 21 individuals – 16 from drilling contracting companies and 5 from BOP OEM companies. The detailed results are provided in Section 4 and Appendix C contains the survey questions.

Section 5 provides a comparison of the MIT activities required by regulations and industry practices and recommended practices to MIT activities currently implemented for BOPs operating in the GoM. This effort identified that the MIT requirements contained in API 53 are referenced or incorporated in most all regulations and industry standards related to BOPs. The comparison of the API 53 activities to the drilling contractors' MIT plans indicated that the API-required tasks comprise about 10% of the maintenance activities performed. The MIT plans include significantly more maintenance activities than required by API 53 and regulations.

Section 6 contains concluding remarks resulting for the MIT activities and MIT management system results. In addition, this section lists 14 potential areas in which improvements could be made.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

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LIST OF FIGURES

LIST OF FIGURES (cont'd)

LIST OF ACRONYMS

ABS	—	American Bureau of Shipping
API	—	American Petroleum Institute
BOP	—	Blowout Preventer
BSEE	—	Bureau of Safety and Environmental Enforcement
C&K	—	Choke and Kill
CCSV	—	Compensated Chamber Solenoid Valve
CMMS	—	Computerized Maintenance Management System
DDV	—	Direct Drive Valve (solenoid valve)
EDS	—	Emergency Disconnect System
EH	—	Electronic – Hydraulic
ERA	—	Electronic Riser Angle
GoM	—	Gulf of Mexico
HKR	—	Remote Hydraulic Regulator
HPHT	—	High Pressure High Temperature
HPU	—	Hydraulic Power Unit
ID	—	Inside Diameter
IOM	—	Installation, Operations, and Maintenance
IP	—	Industry Participant
LED	—	Light Emitting Diode
LMRP	—	Lower Marine Riser Package
MIT	—	Maintenance, Inspection and Test
MKR	—	Manual Hydraulic Regulator
MUX	—	Multiplex
NDE/T	—	Non-destructive Examination/Testing
OD	—	Outside Diameter
OEM	—	Original Equipment Manufacturer
PBOF	—	Pressure Balanced Oil Filled
PM	—	Preventive Maintenance
ROV	—	Remote Operated Vehicle
RP	—	Recommended Practice
SEM	—	Subsea Electronic Module
SPM	—	Subsea Plate-mounted (valve)
UPS	—	Uninterrupted Power Source

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1.0 INTRODUCTION

At the operational stage of an asset's life cycle, asset maintenance and reliability practices for assets are mostly comprised of (1) maintenance, inspection, and test (MIT) activities (i.e., proactive maintenance) and (2) maintenance and reliability management systems. In regards to this project, this report contains a study of these activities and represents one portion of deliverable F associated with Tasks 6.1.1, 6.1. 2 and 6.1.3, as outlined in the contract

MIT activities are conducted to help detect and/or prevent Blowout Preventer (BOP) equipment failures before occurrence and are typically performed on a time and/or event-based schedule. Event-based activities are performed in conjunction with an operation activity such as: running the BOP Stack, upon latching on the wellhead, scheduling a test during drilling operation, prior to drilling out of cased hole, prior to drilling into a known high pressure zone or unplanned retrieval of the BOP. The activities are often based on input from several sources including:

- Statutory regulations (regulations)
- Operator requirements
- Drilling contractor preventive maintenance (PM) programs, including site- or rig-specific programs
- Original Equipment Manufacturer (OEM) recommendations

The maintenance and reliability management systems provide the policies and procedures related to these BOP maintenance and reliability activities:

- MIT program design, implementation, and execution
- Equipment failure elimination and performance improvement
- Equipping personnel to perform MIT maintenance activities

This report provides information related to MIT activities and maintenance and reliability management system practices.

1.1 OBJECTIVES

The objectives of this report are to identify (1) key MIT activities and (2) some of the key maintenance and reliability management system practices impacting BOP reliability performance.

1.2 REPORT ORGANIZATION

This report summarizes the MIT activities (and their associated frequencies) that are: (1) contained in applicable, worldwide regulations, and industry standards and recommended practices and (2) included in industry participants (IP) MIT plans for BOPs operating in the Gulf of Mexico (GoM). In addition, the report provides the results from a reliability and maintenance management system survey. Finally, the report provides a comparison of the MIT activities and practices, and BOP performance.

Section 2 outlines and compares the MIT activities identified in applicable BOP regulations and industry standards and recommended practices. This section identifies the MIT activities and associated frequencies included in the regulations, and in selected industry standards and recommended practices. Section 3 outlines the survey of the current MIT activities included in drilling contractor MIT plans and OEM installation, operations, and maintenance (IOM) manuals. Specifically, Section 3 describes the scope and approach used for this survey and outlines the survey results. Appendix B of this report contains the complete survey results.

Section 4 of this report outlines the reliability and maintenance management system survey approach and summarizes its results. Appendix C contains the survey questions. Section 5 provides a comparison of the MIT activities required by regulations and industry practices and recommended practices to MIT activities currently implemented for BOPs operating in the GoM. Finally, Section 6 contains concluding remarks resulting for the MIT activities and MIT management system results.

2.0 MIT ACTIVITIES - REGULATIONS AND INDUSTRY STANDARDS AND RECOMMENDED PRACTICES

This section contains MIT activities identified in the reviewed regulations, and industry standards and recommended practices. Specifically, this section provides a comparison of the MIT activities included in US regulations, other prominent worldwide regulations, and selected, applicable industry standards and recommended practices. This tabular comparison allows easy identification of common MIT activities, as well as highlights differences in activities and the associated frequencies.

The following subsections identify the scope of this effort and provide a tabular comparison of the MIT activities.

2.1 SCOPE

The scope of this effort involved a review of the regulations and industry standards and recommended practices identified in Table 2-1. Each of these documents were reviewed to identify the MIT activities and associated MIT program requirements related to the BOP equipment listed in Table 2-2. Appendix A provides a more detailed list of items included in each equipment category.

Table 2-1: Regulations and Industry Standards and Recommended Practices

Regulations	Industry Standards and Recommended Practices
Part 250—Oil And Gas And Sulphur Operations In The Outer Continental Shelf, 30 Code of Federal Regulations 250, Washington, District of Columbia.	*Blowout Prevention Equipment Systems for Drilling Wells*, American Petroleum Institute (API) Standard 53, Fourth Edition, American Petroleum Institute Washington, District of Columbia, November 2012.
BOP Classification System For Onshore Newfoundland And Labrador, Interpretation Note Issued Under The Petroleum Drilling Regulations (Cnr 1150/96), Government Of Newfoundland And Labrador, Department Of Natural Resources, Petroleum Resource Development Division, Newfoundland And Labrador, Canada, December 2004.	*Recommended Practice for Well Control Operations*, API Recommended Practice 59, Second Edition, American Petroleum Institute Washington, District of Columbia, May 2006.
Directive 036: Drilling Blowout Prevention Requirements and Procedures, Energy Resources Conservation Board, Calgary, Alberta, Canada, February 2006.	*Specification for Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment*, API Specification 16D (Spec 16D), American Petroleum Institute Washington, District of Columbia, Second Edition, July 2004, Effective Date, January 2005.

Table 2-1: Regulations and Industry Standards and Recommended Practices (cont'd)

Regulations	Industry Standards and Recommended Practices
Blowout Prevention in California: Equipment Selection and Testing, California Department of Conservation, Division of Oil, Gas, and Geothermal Resource, Sacramento, Tenth Edition, 2006.	*Specification for Choke and Kill Systems*, API Specification 16c (Spec WC), American Petroleum Institute Washington, District of Columbia, First Edition, January 1993.
	Specification for Wellhead and Christmas Tree Equipment, ANSI/API Specification 6A, Nineteenth Edition, ISO 10423:2003, (Modified) Petroleum and natural gas industries—Drilling and production equipment—Wellhead and Christmas tree equipment, American Petroleum Institute Washington, District of Columbia, July 2004.
	Guide For The Classification Of Drilling Systems, American Bureau of Shipping, Houston, Texas, March 2011.
	Guideline for the Certification of Blow-Out Preventers, Germanischer Lloyd SE, GL Noble Denton, Hamburg, Germany, May 2011.

Table 2-2: BOP Equipment Scope

BOP Control Systems	BOP Stack Equipment
Surface Control System	
• Electrical Power	• Annulars
• Multiplex (MUX) Control System	• Blind Shear Ram
• Hydraulic Power Unit (HPU)	• Casing Shear Ram
• Rigid Conduit & Hotline	• Pipe & Test Rams
• Surface Accumulators	• Choke & Kill (C&K) Valves and Lines
• Control Panels	• Connectors
Subsea Control System	• Stack-mounted Accumulators
• Blue & Yellow Subsea Control Systems	
• Lower Marine Riser Package (LMRP)-mounted Accumulators	
• Emergency & Secondary Controls	

2.2 MIT ACTIVITY COMPARISON

This section provides the results of MIT activities and practices included the documents listed in Table 2-1. The identified MIT activity requirements are provided in a tabular format to allow comparison of the activities. Table 2-3 summarizes the identified requirements and contains the following information:

- **MIT Activity -** This column identifies a specific requirement included in one or more of the documents reviewed.
- **Industry Standards and Recommended Practices –** The rows in this section of the table provide an indication of whether an industry standard or recommended practice contains a requirement to perform a specific MIT activity. In addition if the industry standard or recommended practice listing the MIT activity includes a specified interval, the interval is included in the table. A blank row indicates that no requirements were identified.
- **Regulations –** The rows in this section of the table provide an indication of whether the regulation contains a requirement to perform a specific MIT activity. In addition if the regulation listing the MIT activity includes a specified interval, the interval is included in the table. A blank row indicates that no requirements were identified.

In addition to the information contained in Table 2-3, the following information regarding other MIT activities and practices were identified:

- American Petroleum Institute (API) Recommended Practice (RP) 53 includes a requirement to develop and implement a planned maintenance program for each rig.
- API RP 59 references sections of API RP 53 containing maintenance requirements.

Also, this review included the following documents which contain equipment related inspection and testing activities, but these activities are intended for application during the fabrication and/or manufacturing of the BOP components or systems.

- *Specification for Choke and Kill Systems*, First Edition, API Specification 16C.
- *Specification for Drilling Well Control Equipment and Control Systems for Diverter Equipment,* API Specification 16D.
- *Specification for Drill-through Equipment,* Third Edition, API Specification 16A.
- *Specification for Wellhead and Christmas Tree Equipment,* Nineteenth Edition, ANSI/API Specification 6A.

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Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities

MIT Activity			
Operational Components Function Test	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	❖ At least once per week
		API 53 4th Ed., Nov 2012	❖ At least once per week
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ BOP Systems tested when installed ❖ BOP Systems tested at least every 7 days ❖ BOP systems tested following repairs that require disconnecting a pressure seal in the assembly ❖ Function test annular and RAM BOPs every 7 days between pressure tests[12]
		Blowout Prevention in California	❖ 24-hrs, function test of pipe rams, blind rams, kelly cocks, drill pipe safety valve, adjustable chokes, hydraulic valves ❖ At least once every seven days, function test of annular preventer, all gate valves in choke and kill system, and manually operated BOP
		ERCB Directive 36	❖ Daily function test of annulars(s) and pipe rams ❖ Daily function of blind rams when drill string is out of the hole ❖ Weekly function test of HCR ❖ Function test of annular and HCR prior to drilling, for wells with a diverter system
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
BOP Pressure Gauges calibration	Industry Standards and Recommended Practices	API RP 53, 3rd Ed.	❖ At least every 3 years (to 1% accuracy)
		API 53 4th Ed., Nov 2012	❖ Annual calibration in accordance with OEM procedures
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	30 CFR 250	
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity	Industry Standards and Recommended Practices	API RP 53, 3rd Ed.	
Electronic Pressure Measurement Devices Calibration		API 53 4th Ed., Nov 2012	❖ No timing specified but devices must be calibrated within 1% and utilize the manufacturer's specified range
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	30 CFR 250	
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
Low Pressure Test[10]	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ BOP stack initially installed on wellhead[1,4,7] ❖ While on wellhead, Not to exceed 21 days[1,4] ❖ After the disconnection or repair of any pressure containment seal but limited to the affected component[16]
		API 53 4th Ed., Nov 2012	❖ Predeployment of the BOP subsea and upon installation ❖ after the disconnection or repair of any pressure containment seal in the BOP stack, choke line, kill line, choke manifold, or wellhead assembly but limited to the affected component; ❖ In accordance with equipment owner's PM program or site-specific requirements; ❖ Not to exceed intervals of 21 days
		ABS Guide for Classification of Drilling Systems	❖ Annual survey includes low pressure test of BOP in accordance with API RP 53
		CNLR 1150/96	❖ After installation ❖ Before drilling out a string of casings installed in a well ❖ Before connecting a formation flow test or a series of test ❖ Following repairs that require disconnecting a pressure seal in the wellhead assembly ❖ Not less than once every 15 days
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ When BOP stack initially installed on wellhead[7] ❖ Before 14 days elapse since last BOP pressure test ❖ Before drilling out each string of casing or liner ❖ Before the high pressure test ❖ Interval for blind or blind-shear pressure tests may not exceed 30 days
		Blowout Prevention in California	
		ERCB Directive 36	❖ Prior to drilling out the surface, intermediate, and production casing[9]
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
High Pressure Test[10]	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	❖ BOP stack initially installed on wellhead[1,4,5,7] ❖ While on wellhead, not to exceed 21 days[1,4,5] ❖ After the disconnection or repair of any pressure containment seal but limited to the affected component[16]
		API 53 4th Ed., Nov 2012	❖ Predeployment of the BOP subsea and upon installation; ❖ After the disconnection or repair of any pressure containment seal in the BOP stack, choke line, kill line, choke manifold, or wellhead assembly but limited to the affected component; ❖ In accordance with equipment owner's PM program or site-specific requirements; ❖ Not to exceed intervals of 21 days
		ABS Guide for Classification of Drilling Systems	❖ Annual survey includes high pressure test of BOP in accordance with API RP 53
		CNLR 1150/96	❖ After installation ❖ Before drilling out a string of casings installed in a well ❖ Before connecting a formation flow test or a series of test ❖ Following repairs that require disconnecting a pressure seal in the wellhead assembly ❖ Not less than once every 15 days
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ BOP stack initially installed on wellhead[7] ❖ Before 14 days elapse since last BOP pressure test ❖ Before drilling out each string of casing or liner ❖ After the low pressure test ❖ Interval for blind or blind-shear pressure tests may not exceed 30 days
		Blowout Prevention in California	❖ High pressure testing after each subsequent casing string is set
		ERCB Directive 36	❖ Prior to drilling out the surface, intermediate, and production casing[10, 11]
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
BOP Control System Function Test[3]	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ BOP stack initially installed on the wellhead[I] ❖ While on wellhead, not to exceed 21 days[17]
		API 53 4th Ed., Nov 2012	❖ See Operational Components Function Test category
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	❖ All major components of the BOP system, except the blind rams, are actuated once each day that drilling operations are carried out if the drill string is out of the hole or the drill bit is in the casing ❖ All major components of the BOP system, except the blind rams, are actuated at least once every 3 days ❖ The blind rams are actuated at least once each time that the drill string is out of the hole
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ Function test annular and RAM BOPs every 7 days between pressure tests
		Blowout Prevention in California	❖ At least once during an 8-hour tour actuate all audible and visual indicators ❖ At least every 24-hrs, function test of pipe rams, blind rams, kelly cocks, drill pipe safety valve, adjustable chokes, hydraulic valves ❖ At least once every seven days, function test of annular preventer, all gate valves in choke and kill system, and manually operated BOP valves
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
Accumulator Pressure Precharge Verification	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ The precharge pressure on each accumulator bottle should be measured prior to each BOP stack installation on each well and adjusted if necessary
		API 53 4th Ed., Nov 2012	❖ After installation ❖ Every 6 months after each pressure test ❖ After any repair that required isolation/partial isolation of the system
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	❖ At least once during 8-hour tour
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity			
Critical BOP Elastomeric Components Replacement (suggested activity)	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ Change out as soon as possible after exposure to hydrogen sulfide ❖ When well control equipment has been out of service for 6 months or longer
		API 53 4th Ed., Nov 2012	❖ Consider replacing BOP elastomeric components on wellhead equipment that has been out of service for 6 months and not preserved according to equipment owner's guide ❖ After exposure to hydrogen sulfide (H2S) and/or CO2, under pressure, in accordance with the original equipment manufacturer (OEM) or equipment owner's requirements
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
Well Control Equipment Cleaning, Visual Inspection, Preventive Maintenance, and Pressure Test	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	❖ After each well is drilled, the well control equipment should be cleaned, visually inspected, preventive maintenance performed, and pressure tested before installation on the next well
		API 53 4th Ed., Nov 2012	❖ Inspection and maintenance of the well control equipment shall be performed in accordance with the equipment owner's PM program. ❖ The equipment owner's PM program shall address inspection (internal/external visual, dimensional) and pressure integrity testing. Inspections shall be performed every 90 days, after each well is drilled, or in accordance with documented equipment owner's reliability data, whichever is greater ❖ Certain well operations or conditions (e.g. milling, well control events, bromide use, etc.) will require more frequent inspection and maintenance
		ABS Guide for Classification of Drilling Systems	❖ Special periodical survey every 5 yr. including examination of the equipment associated with the well control system and their maintenance records[15]
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	❖ Annual inspection, described in Section 4 ❖ Every five years, an Inspection for Re-Certification shall be carried out, described in Section 5
	Regulations	**30 CFR 250**	❖ BOP stack initially installed on wellhead[7] ❖ Following repairs that require disconnect of a pressure seal
		Blowout Prevention in California	❖ At least once during an 8-hour tour actuate all audible and visual indicators
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
Flexible Choke and Kill line Visual External Inspection	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ A full internal and external inspection of the flexible choke and kill lines should be performed in accordance with the equipment manufacturer's guidelines.
		API 53 4th Ed., Nov 2012	❖ The external inspection programs shall be performed as specified by the equipment owner's PM program in accordance with equipment manufacturer's recommendations.
		ABS Guide for Classification of Drilling Systems	❖ Annual survey specified in detail in Section 5.3
		CNLR 1150/96	❖
		GL Noble Guideline for Certification of Blow-Out Preventers	❖ Annual inspection, described in Section 4 ❖ Every five years, an inspection for Re-Certification shall be carried out, described in Section 5 ❖ Extraordinary inspection after BOP or its components suffer damage
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	
MIT Activity			
BOP Stack and Choke Manifold Disassembly and Inspection[6]	Industry Standards and Recommended Practices	**API RP 53, 3rd Ed.**	❖ Every 3-5 years of service
		API 53 4th Ed., Nov 2012	❖ At least every 5 years
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	❖ Annual inspection ❖ Inspection for recertification after 5 years ❖ Extraordinary inspection after BOP or its components suffer damage
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity		API RP 53, 3rd Ed.	
BOP Visual Inspection	Industry Standards and Recommended Practices	API 53 4th Ed., Nov 2012	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	30 CFR 250	❖ Daily (for surface BOP systems) ❖ Visual inspection every 3 days, weather and sea conditions permitting (for subsea BOP and marine riser)
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity		**API RP 53, 3rd Ed.**	
BOP Stump Test	Industry Standards and Recommended Practices	API 53 4th Ed., Nov 2012	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	30 CFR 250	❖ Before installation
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
BOP Inspections	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
		API 53 4th Ed., Nov 2012	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ Must meet or exceed provisions in Section 18.10 in API RP 53[14]
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
BOP Maintenance		**API 53 4th Ed., Nov 2012**	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	❖ BOP maintenance must meet or exceed provisions in Sections 18.11 and 18.12 in API RP 53[14]
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity			
Audible and Visual Indicator Actuation Test	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
		API 53 4th Ed., Nov 2012	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	❖ At least once during an 8-hour tour
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity			
Subsea Systems Visual Inspection	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
		API 53 4th Ed., Nov 2012	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	❖ At least once each day, weather and sea conditions permitting
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
Subsea Equipment Inspection and Maintenance		**API 53 4th Ed., Nov 2012**	
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	
	Regulations	**30 CFR 250**	
		Blowout Prevention in California	❖ No timing specified other than inspect and maintain in accordance with manufacturer's recommended procedures
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	❖ Set performance criteria for components
MIT Activity	**Industry Standards and Recommended Practices**	**API RP 53, 3rd Ed.**	
Surface BOP System Testing and Maintenance		**API 53 4th Ed., Nov 2012**	❖ Table 6 specifies frequency for surface testing[18]
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	❖ Annual inspection ❖ Inspection for recertification after 5 years ❖ Extraordinary inspection after BOP or its components suffer damage
	Regulations	**30 CFR 250**	❖ Daily visual inspection ❖ BOP inspections must meet or exceed provisions in Section 18.10 in API RP 53[13] ❖ BOP maintenance must meet or exceed provisions in Sections 18.11 and 18.12 in API RP 53[14]
		Blowout Prevention in California	
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

MIT Activity		API RP 53, 3rd Ed.	
Subsea BOP System and Marine Riser Inspection and Recertification	**Industry Standards and Recommended Practices**	**API 53 4th Ed., Nov 2012**	❖ Table 7 specifies Subsea testing[19] ❖ Table 8 specifies other system tests ❖ Table 9 specifies pre-deployment pressure tests for Floating Rigs with Subsea BOP stacks ❖ Table 10 specifies subsea pressure tests for Floating Rigs with Subsea BOP stacks
		ABS Guide for Classification of Drilling Systems	
		CNLR 1150/96	
		GL Noble Guideline for Certification of Blow-Out Preventers	❖ Annual inspection ❖ Inspection for recertification after 5 years ❖ Extraordinary inspection after BOP or its components suffer damage
	Regulations	**30 CFR 250**	❖ Visual inspection every 3 days, weather and sea conditions permitting ❖ Stump test Subsea BOP system before installation ❖ BOP inspections must meet or exceed provisions in Section 18.10 in API RP 53 ❖ BOP maintenance must meet or exceed provisions in Section 18.120 in API RP 53
		Blowout Prevention in California	❖ All subsea equipment must be inspected and maintained in accordance with manufacturer's recommended procedures ❖ All subsea systems must be visually inspected at least once each day, weather and sea conditions permitting
		ERCB Directive 36	
		Norsok Standard D-010, Rev. 3	

1 Includes testing of annular, ram preventers, BOP-to WHD connector, choke & kill lines & valves, and choke & kill manifold
2 Includes testing of BOP control system manifold(s)
3 Function test includes close time, pump capability, and control station tests
4 Includes testing of casing seals and BOP choke manifold
5 Includes optional testing of control system manifold and BOP lines
6 Includes change out of elastomeric components, examination of surface finishes for corrosion and wear, check of dimensional parameters, and internal and external inspection of flexible choke and kill lines
7 Includes choke manifold, Kelly valves, inside BOP, and drill-string safety valve
8 Includes ram blowout preventers, ram blocks and packers and top seals, annular blowout preventers, annular packing units, hydraulic connectors, drilling spools, adapters, loose connections, clamps
9 Includes testing of annular, rams, bleed-off line and valves, manifold valves, kill line and valves, stabbing valve, inside BOP, lower Kelly cock, and surface/intermediate/production casing at 1400 kPa for 10 minutes
10 Prior to drilling out surface case; includes testing of annular, rams, bleed-off line and valves, manifold valves, kill line and valves, stabbing valve, inside BOP, lower Kelly cock, and surface casing at the lesser of 7000kPa or 50 times setting depth in meters of the surface casing for 10 minutes
11 Prior to drilling out intermediate or production casing; annular must be tested at 50% of the working pressure of the required BOP system for the well class for 10 minutes; rams, bleed-off line and valves, manifold valves, kill line and valves, stabbing valves, inside BOP, and lower Kelly cock must be tested to the minimum of the required BOP system based on well class for 10 minutes; intermediate or production casing must be tested at a pressure equal to 67% of the BHP at the casing setting depth
12 Includes test of annular and ram BOPS

Table 2-3: Regulations and Industry Standards and Recommended Practices MIT Activities (cont'd)

13 After each well, well control equipment should be inspected per the manufacturer's recommendation. Test recommendations are provided in Table 3. Specifies visual inspection of choke & kill lines. Specifies major inspection every 3 to 5 years (disassembly and inspection of BOP stack, choke manifold, and diverter components, change out elastomeric components, full internal and external inspection of flexible choke & kill lines

14 OEM manuals should be available for all BOP equipment on the rig, planned maintenance system should identify equipment, maintenance tasks specified and time interval, the rig maintenance and inspection schedule should provide for periodic nondestructive examination of the mudgas separator to verify pressure integrity. This examination may be performed by hydrostatic, ultrasonic, or other examination methods

15 Special periodical survey includes all items listed under Annual Survey and review of OEM maintenance records to verify: 1) periodical testing requirement reconditioning, 2) reconditioning of well control equipment, BOP controls, riser system, pressure vessels, electrical systems/equipment drilling hoisting system; internal examination of pressure vessels, testing of relief valves and pressure piping systems,; hydrostatic testing of drilling piping systems, pressure vessel, and hydraulic hoses

16 Any pressure containment seal in the BOP stack, choke line, choke manifold, or wellhead assembly.

17 The elements of the BOP control system normally include: a. Storage (reservoir) equipment for supplying ample control fluid to the pumping system, b. Pumping systems for pressurizing the control fluid, c. Accumulator bottles for storing pressurized control fluid (some accumulator bottles may be located subsea on the BOP stack assembly), d. Hydraulic control manifold for regulating the control fluid pressure and directing the power fluid flow to operate the system functions (BOPS and choke and kill valves), e. Remote control panels for operating the hydraulic control, manifold from remote locations, f. Hydraulic control fluid, g. Umbilical control hose bundle(s) and reel(s), and h. Control pod(s) located on the BOP

18 Secondary, emergency, and other systems including Emergency Disconnect System/Sequence, Autoshear System Deadman System, remote operated vehicle (ROV) Intervention, Acoustic Control System

19 Secondary, emergency, and other systems including Emergency Disconnect System/Sequence, Autoshear System Deadman System, ROV Intervention, Acoustic Control System, Dedicated Emergency Accumulators

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3.0 MIT ACTIVITIES – IP MIT PLANS AND OEM IOM MANUALS

This section summarizes the current MIT activities applied to BOPs operating in the GoM. Specifically, this section includes a survey of MIT activities based on the following information:

- Drilling contractor MIT plans which include statutory regulation requirements, operator requirements, the drilling contractor's own PM programs, and site- or rig-specific programs
- BOP OEM defined MIT plans intended to preserve warranty and maintain equipment integrity, over and above the regulatory activities

The survey of these plans provides information related to the MIT activities performed during drilling operations. The following subsections identify the scope of this effort, describe the approach used to collect the information and provide the tabular results of the MIT activities.

3.1 SCOPE

The scope of this effort included identifying MIT activities contained in drilling contractors' MIT plans and OEM IOM manuals. In total, more than 200 documents (i.e., MIT plans, well control manuals, and OEM IOM manuals) were included in this scope. In addition, this effort focused on identifying MIT activities for the following phases of BOP operation:

- **Between Well –** When the drilling program is completed and the well is secured, the BOP Stack is brought to the surface and prepared for the next well. The extent of MIT between wells is governed by the drilling contractor and/or operator and/or site-/rig-specific procedures and programs. MIT activities typically include limited disassembly of components, replacement of some consumables and resolution of any deferred maintenance.
- **Pre-drilling**: This describes activities performed to ensure the BOP System is operating in accordance with design parameters, statutory regulations and individual drilling contractor and/or operator requirements. Pre-drilling is composed of two event-based activities.
    i. Prior to Deployment: The final MIT performed on the surface prior to running the BOP. Unlike subsea tests, the pre-deployment test typically tests all functions.
    ii. Upon Latching/Initial test upon latching: Performed when the BOP is latched on the well head and before drilling operations begin. In the event that the BOP has been retrieved and re-run to facilitate repairs, weather or other operations, MIT criteria will vary between individual drilling contractors and operators.
- **Drilling**: Inspections and tests during drilling operations while the BOP Stack is latched on a wellhead and during the course of the drilling program. MIT activities

are either calendar or event-based. MIT events during a drilling program are sometimes limited by operational limitations and concerns.

Scheduled Major Overhauls – These are procedures to recertify equipment and require disassembly to the module level with parent material identification/parent material analysis, non-destructive evaluation and testing (NDE/T), and dimensional inspection and can include remanufacture of components. The frequency of recertification is prescribed by statutory regulations and/or drilling contractor PM program. The scope of inspection and verification to achieve recertification is determined by the OEM or owner of the design. In the event that an overhaul procedure involves multiple components, some drilling contractors choose to overhaul or replace a percentage of the components on an annual basis.

3.2 INFORMATION COLLECTION AND COMPILATION

This section outlines the approach used to collect MIT activities and compile the information into a tabular format. The information collection started by developing a list of information to be requested from the IPs. Specifically, the list requested that the IPs provide BOP IOM manuals and/or MIT plans containing this information:

- MIT activities performed, including planned maintenance, predictive maintenance, scheduled inspections, and scheduled tests performed to detect or prevent failures (i.e., proactive maintenance activities versus corrective maintenance activities)
- Indication of the operating/maintenance regime (i.e., pre-drilling, drilling, in-between wells, scheduled overhauls) when each MIT activity is to be performed
- Frequency that each MIT activity is to be performed
- BOP equipment included in the MIT activity

(Note: Some MIT activities are event-based such as activities performed during pre-drilling and in-between wells. Other MIT activities are time-based, such as those performed during drilling, between wells and scheduled overhauls.)

The MIT activities were to reflect the tasks performed to comply with regulatory requirements and industry practices (e.g., MIT activities included in API 53), as well as other tasks performed to ensure the safe operation and reliability of BOP systems.

Once the requested information was collected, the information provided was reviewed for use in this deliverable. The relevant information was then extracted and compiled. In compiling the information, the following activities were performed:

- Review of all the collected information and manuals for MIT information
- Extraction of relevant MIT information from the information and manuals
- Transfer of the MIT information into a tabular format

- Review of the respective information by industry participants and American Bureau of Shipping (ABS) personnel
- Compilation of the information into a series of tables by OEM and drilling contractor provided information

In general, the information was transferred "as-found" in the respective IP's information. However, the information was reviewed to identify any details which would indicate the source of the information (e.g., reference to a specific procedure, reference to a specific OEM manual). As these instances were identified, the MIT information was altered, usually by simply removing the source reference, in a manner not to alter the intent of the content. Also, each MIT activity was classified into one of the following proactive maintenance categories:

- Planned Maintenance – A time-based activity designed to prevent a BOP component failure by maintaining/restoring the component's reliability through servicing and/or repairing or replacing specific BOP components.
- Predictive Maintenance – An activity designed to detect the onset of failure by measuring and analyzing of key component operating or performance parameters related to the failure mode of interest.
- Scheduled Inspection – A scheduled activity designed to check or verify the condition of a BOP component, usually taken to be a visual inspection or some type of non-destructive testing.
- Scheduled Test – A scheduled activity designed to detect the condition related to the onset of failure or hidden failure of a BOP component, usually via a functional or performance test.

Because the IOM manuals, MIT plans, and well control manuals did not always clearly identify the operating/maintenance regime when the MIT activity was to be performed, the following conventions were used:

- Event-based MIT activities identified as between well were also assigned as pre-drill MIT activities
- Time-based MIT activities involving testing or inspections with 30 days or less frequency were assigned as drilling MIT activities
- Some MIT activities which could not be associated with a specific operating/maintenance regime were included as Miscellaneous (activities).

3.3 IP MIT Activity Survey Results

The results of the survey of current MIT activities are summarized in tables which outline the BOP MIT activities included in the IOM manuals, MIT plans, and well control manuals. Specifically, the compiled MIT activities are presented in tabular format with the MIT activities included in the BOP IOM manuals and MIT plans being provided as a series of tables in Appendix B. These tables contain the following columns and associated information:

- BOP System and Subsystem Columns – These columns identify the BOP system and subsystem in which the MIT activities are associated with either in IOM manual or the first level of indenture in the drilling contractor's Computerized Maintenance Management System (CMMS) equipment hierarchy.
- Component Column – This column identifies the specific component(s) associated with the MIT activity, as applicable. (Note: Some component table cells are blank because the MIT activity is applicable to multiple components.)
- MIT Activity – This column provides a description of the specific MIT activities planned for the component group. These descriptions include a brief description of the MIT activity and usually the BOP component(s) involved. Please note these descriptions were transferred directly from the provided information with the only alteration being removal of references which would identify the information's source.
- Maintenance Activity Type – This column provides ABS Consulting's classification of the type of MIT activity as follows based on the following conventions:
    - Planned Maintenance
    - Predictive Maintenance
    - Scheduled Inspection
    - Scheduled Test
- MIT Activity Interval – This series of columns indicates the operating/maintenance regime in which each specific MIT activity is planned to be performed, as well as, provides the specific time-based interval or event for each MIT activity.

Appendix B contains MIT activities in the following four tables:

- Overall BOP MIT Activities
- Surface Control System MIT Activities
- Subsea Control System MIT Activities
- BOP Stack MIT Activities

4.0 MIT MANAGEMENT SYSTEM SURVEY

In addition to MIT activities, other key components of BOP reliability performance are the maintenance- and reliability-related management systems. These management systems are important because they define policies and procedures related to the key activities such as, (but not limited to):

- Defining MIT activities to be executed, including statutory requirements
- Scheduling , executing, and documenting MIT activities
- Identifying equipment failures and implementing appropriate corrective actions
- Trending and eliminating equipment failures
- Ensuring proper information and instructions are provided to personnel who perform BOP maintenance
- Providing personnel who perform BOP maintenance appropriate training

The survey's objective was to identify maintenance and reliability management system practices currently implemented by drilling contractors and OEMs relative to maintaining BOPs. The following sections identify the scope of this effort, describe the approach used to perform the survey, and provide the survey results.

4.1 SCOPE

The survey focused on evaluating the presence and implementation of management systems related to the following BOP maintenance and reliability activities:

- Identification and elimination of BOP failures
- Use of CMMS or other computer tools
- Implementation of generally accepted maintenance management practices, such as scheduling and planning
- PM program
- Operation and optimization of the PM program
- Use and quality of written instructions for BOP maintenance
- Training of personnel who perform BOP maintenance

Specifically, the survey was provided to both drilling contractors and BOP OEMs for distribution within their respective organizations. The targeted positions for the survey within these organizations were:

- BOP Maintainers
- BOP Maintenance Supervisors
- Maintenance Planners
- Maintenance Schedulers
- Other Maintenance and Engineering Support Personnel

- Rig Operation Leaders
- Rig Operations Supervisors
- Reliability and Maintenance Engineers

4.2 MANAGEMENT SYSTEM SURVEY APPROACH

Based on similar maintenance and reliability surveys and management system assessments, ABS Consulting developed a series of survey questions related to 1) the participant demographics, and 2) the focal management systems listed above. In general, the management system survey questions inquired about the existence of a management system, the formality of the management system implementation (e.g., undocumented, documented), and the consistency and degree of implementation. In addition, the survey questions were designed to solicit input from both field personnel, and office and management personnel. This approach provides the capability to compare designed/planned implementation to actual implementation. The following provides an overview of the survey questions for each category:

- Demographics – Six questions related to each participant's experience level, job position and role, and BOP manufacturer experience
- Failure Elimination – Nine questions related to the identification and reporting of BOP failures, the analysis of failures, and the implementation of corrective actions
- CMMS – Four questions related to the existence of a CMMS or a similar computer system, field personnel's use of the CMMS, and management personnel's use of the CMMS.
- Maintenance management practices – Seven questions related to the existence and implementation of a formal maintenance work control process and procedures, including use of work orders, assignment of work, and planning and scheduling of work.
- PM program – Five questions related to the development of PMs, the basis for PM frequencies, and optimization of PM activities.
- Written Instructions – Seven questions related to the existence of written instructions for BOP repairs and PMs, the field use of written instructions, the content of the written instructions, and the quality of the instructions.
- Training - Three questions related to training of personnel who perform BOP maintenance, including timing and content of initial and refreshing training.

The specific survey questions are provided in Appendix C. These survey questions were configured in a web-based survey tool and then the survey link was provided to drilling contractors and OEM project leads for distribution within their respective organizations.

The survey results were collected electronically over a 2 ½-week period. The results were then compiled and analyzed for trends.

4.3 MANAGEMENT SYSTEM SURVEY RESULTS

The survey results consist of a summary of the number of respondents and their demographics, and evaluation and comparison of the management systems employed by drilling contractors to those employed by BOP OEM. (*Note: The survey responses were provided by individuals, and therefore. the response reflect individual's opinions rather than any specific organization's policy or operation. In addition due the small number of respondents, readers are caution not to develop firm conclusions about the respective management system performance based solely on these results.)*

4.3.1 Demographic Results

The survey included responses from 21 participants – 16 drilling contractor participants and 5 BOP OEM participants. The survey included responses from personnel in operations, maintenance, rig management and technical support job roles. All of the respondents completed the manager version section of the survey questions provided in Appendix C. In addition, the respondents averaged more than 10 years of offshore experience and nearly 50% of the respondents have been in their current position for 5 or more years. Figures 4-1 through 4-4 provide the specific demographics of the survey participants.

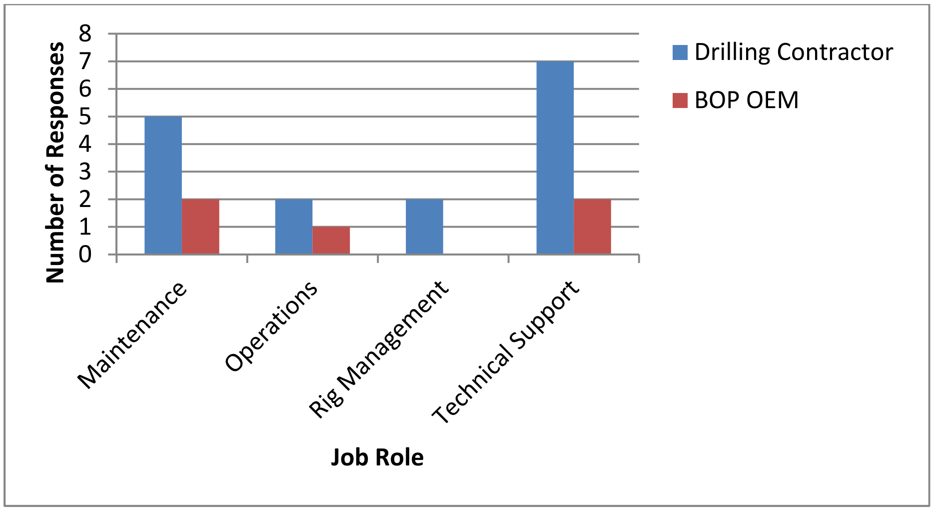

Figure 4-1. Respondent Job Roles

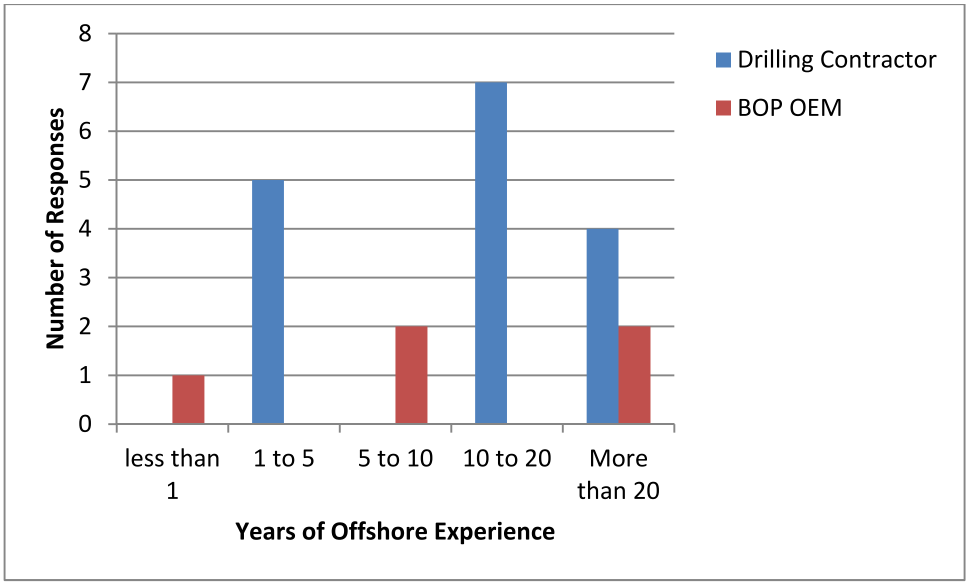

Figure 4-2. Respondent Offshore Experience

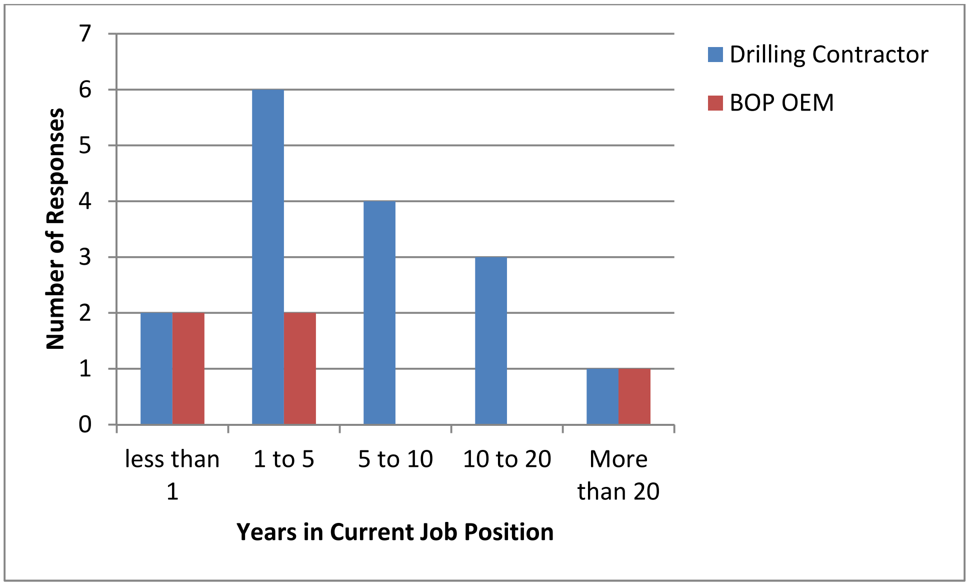

Figure 4-3. Respondent Current Job Experience

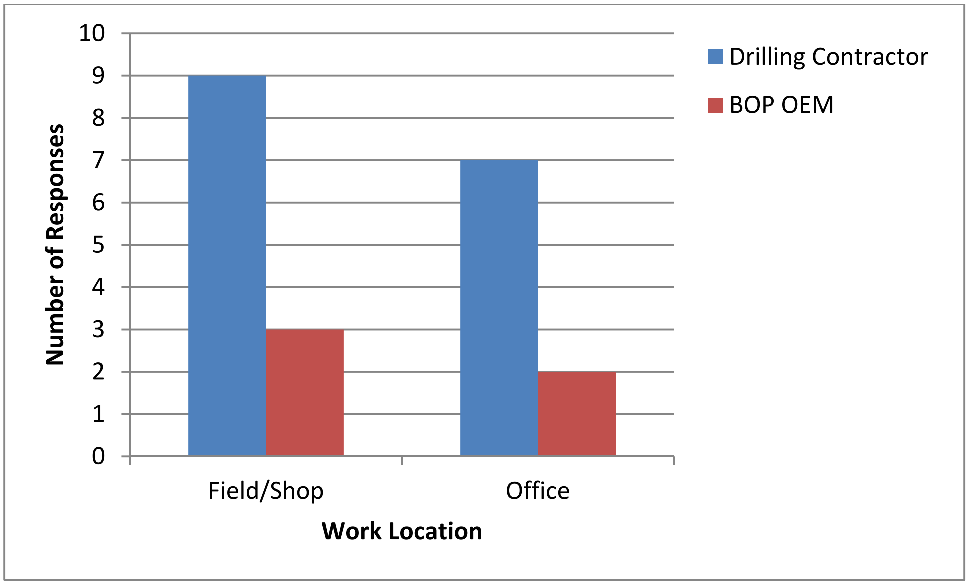

Figure 4-4. Respondent Work Location

4.3.2. Failure Elimination Results

The survey focused on 3 portions of the failure elimination process – identification and documentation, investigation, and corrective actions. Figures 4-5 to 4-8 provide the results related to identification and documentation of failures. Figure 4-5 indicates drilling contractors are identifying and documenting BOP failures having lesser impact, in addition to the larger impact failures. BOP OEM response seems appropriate given they are most likely only involved when more significant BOP failures occur.

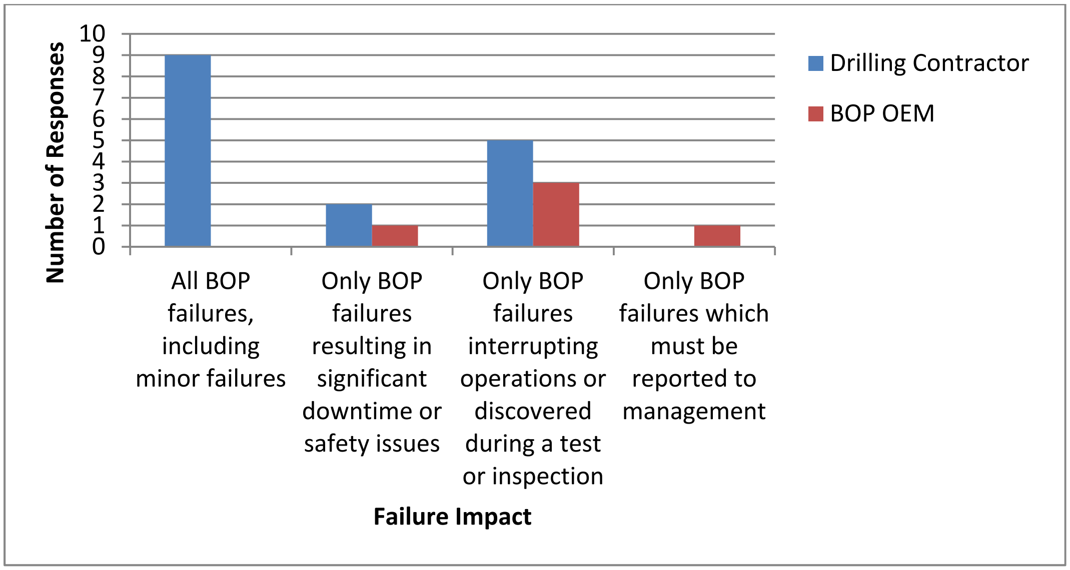

Figure 4-5. BOP Failure Identification and Documentation

Figure 4-6 indicates work order is most common approach used by drilling contractors for documenting BOP failures. In addition, some drilling contractors and OEMs appear to have established dedicated failure tracking systems. Based on performance in other industries, dedicated failure tracking system are proven effective for identifying failure trends, driving continuous improvement, and ensuring organizational awareness of critical equipment failures.

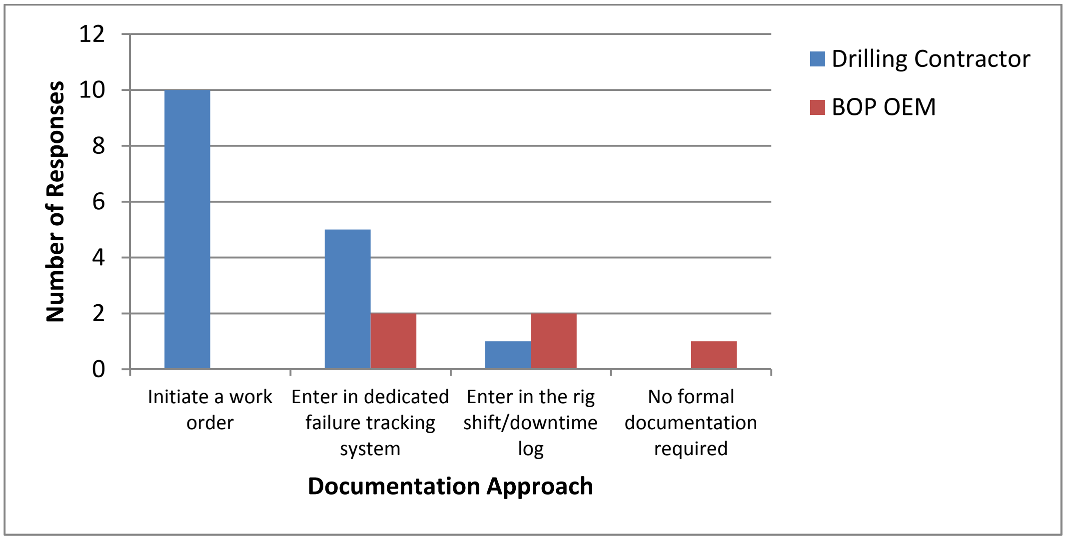

Figure 4-6. BOP Failure Documentation Approach

The final result relates to existence (or knowledge of existence) of a written procedure for identifying and documenting BOP equipment failures. This question provides indication about the sustainability and consistency of the management system related to BOP failure identification and documentation. Figure 4-7 contains the survey results, which indicate about 60% of the participants, indicated a written procedure was in place.

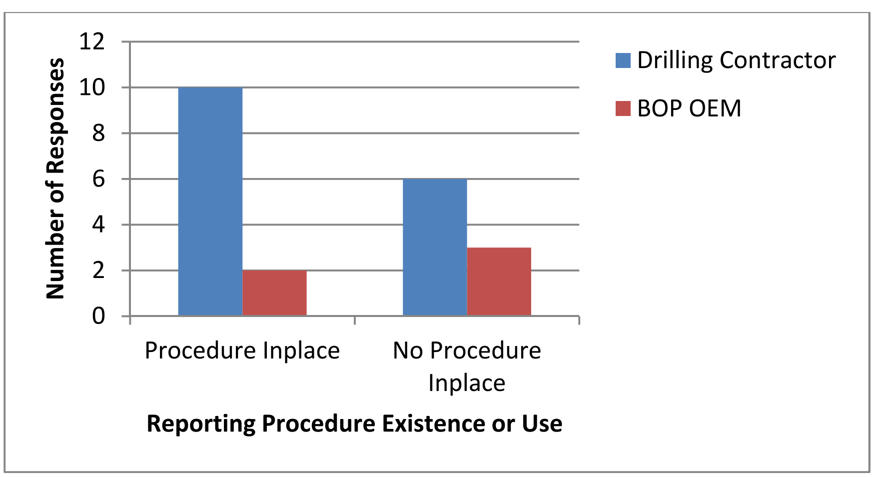

Figure 4-7. BOP Equipment Failure and Condition Reporting Procedure

Next, the survey inquired about the investigation of BOP failures. Specifically, the survey investigated which BOP failures were formally investigated and what the formal investigation process involves. Figure 4-8 shows which BOP failures are formally investigated. Two thirds of the survey participants indicated BOP failures were investigated if the failure impact results in a safety issue or significant downtime. Also based on these results, trending of repeat failures does not appear to be a common trigger for a formal investigation.

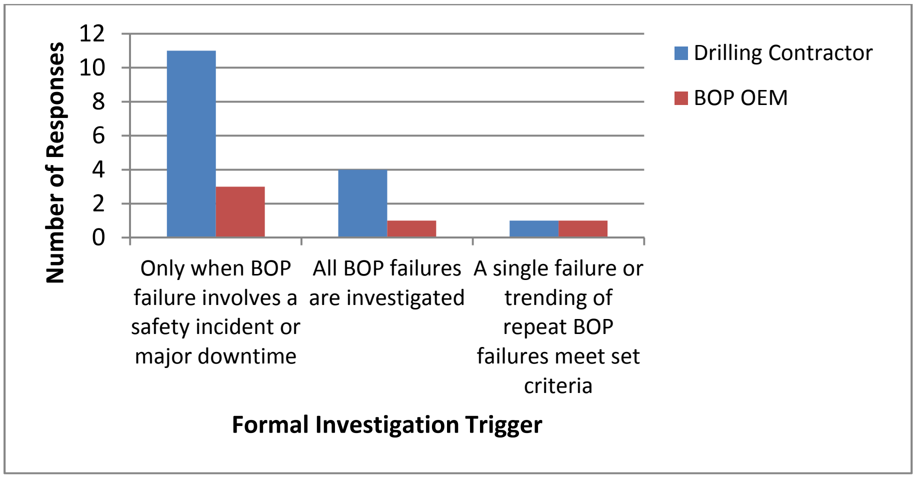

Figure 4-8. BOP Failures Resulting in Formal Investigation

The survey inquired about the types of tools used in the formal investigations, and the organizations participating in the formal investigation. Figure 4-9 provides the survey results related to the investigation tools used. These results indicate forensic-type failure analysis, structured root cause analysis, and data gathering are used by both the drilling contractors and BOP OEMs. These are all good practices. In addition, the drilling contractors use a multi-discipline investigation teams.

Figure 4-10 provides the results related to the differing organizations typically participating in formal investigations. A high percentage of the drilling contractor respondents indicate involvement from multiple organizations in formal investigations. While the BOP OEM participants did not indicate the use of multiple-discipline teams (see Figure 4-9), these results seem to indicate investigations might include personnel from more than one part of their organization.

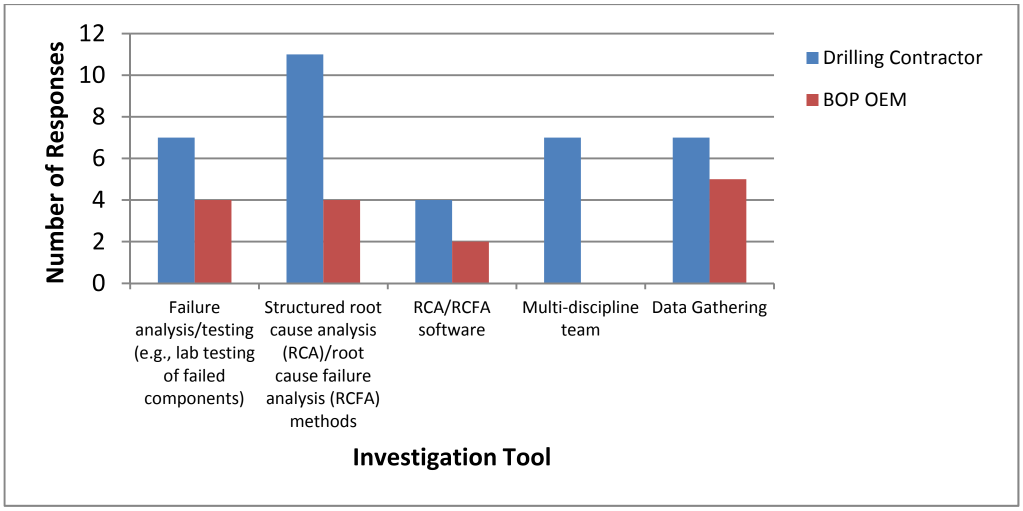

Figure 4-9. Tools Used in Formal Investigations

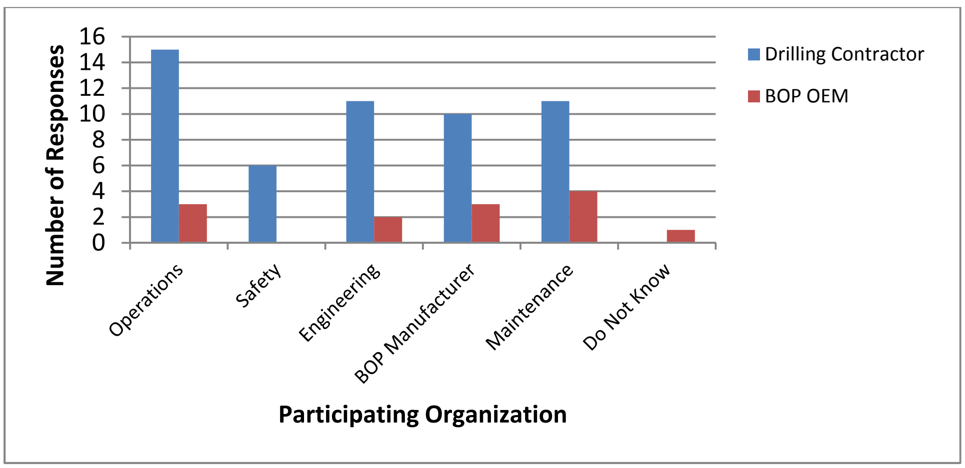

Figure 4-10. Formal Investigation Participants

The last failure elimination survey questions related to the corrective actions developed by the formal investigation. Specifically, the survey inquired about the type (or level) of corrective actions typically resulting from the investigation and then the tracking mechanisms used to ensure corrective actions were implemented. Figure 4-11 provides the results related to the type (or level) of corrective actions resulting from investigations. These results indicate a tendency by both the drilling contractors and BOP OEMs to develop a spectrum of corrective actions which address the basic causes of the specific failure, specific equipment improvements for the failed equipment item and similar equipment items, personnel performance issues, and finally management systems changes/improvements. This is a good trend, especially, with many of the respondents indicating management system corrective actions typically result from formal investigations.

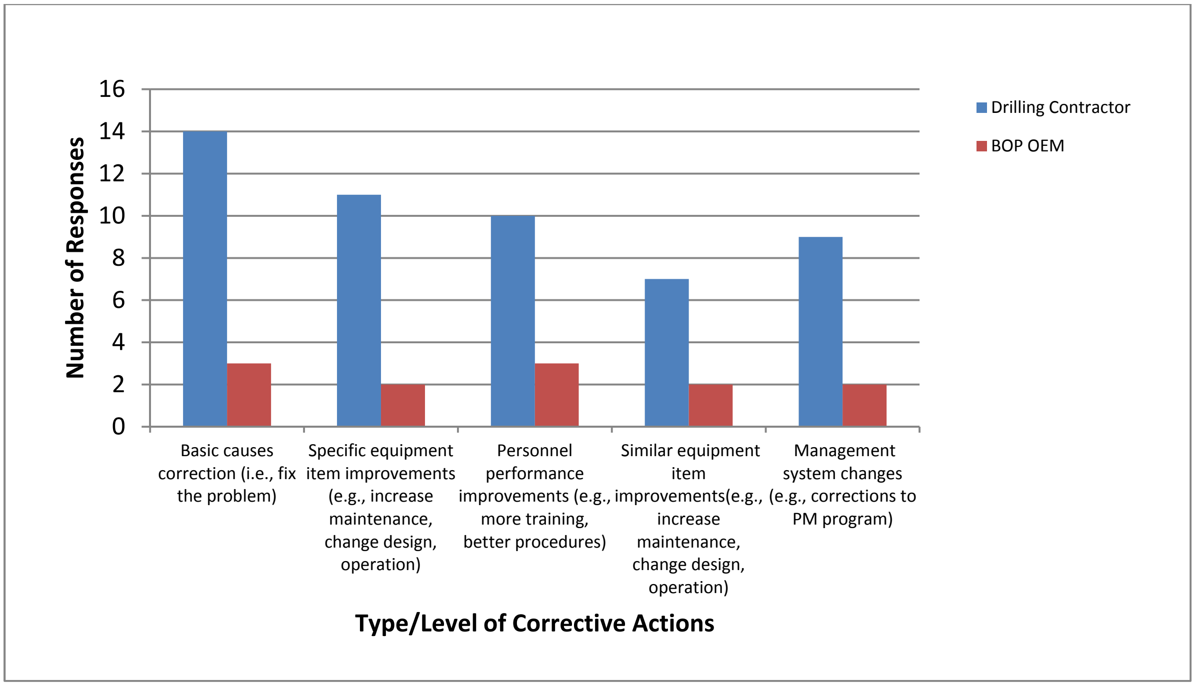

Figure 4-11. Formal Investigation Corrective Actions

Finally, Figure 4-12 provides the survey results related to corrective action tracking mechanisms used. While 60% of the respondents indicated some form of corrective action tracking was in place, the number indicating there was no formal tracking process is an indication that some IPs may not have a tracking system or their personnel are not aware of corrective action tracking. In either case, this is indication that improvement in this area may be warranted.

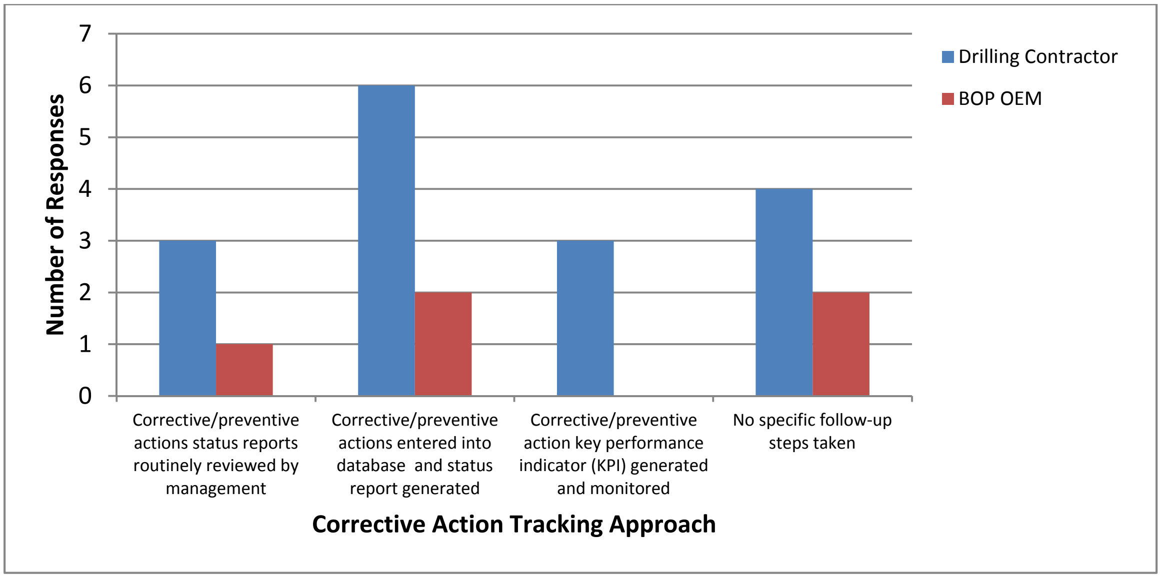

Figure 4-12. Corrective Action Tracking

4.3.3 CMMS Results

Another area surveyed related to the use of a CMMS (or similar computer system), and the system's use in BOP maintenance. The first area of inquiry related to use of CMMS (or similar system) to manage BOP maintenance and length of time in the CMMS had been in use. These results are provided in Figures 4-13 and 4-14 respectively. Figure 4-13 show 81% of drilling contractor and 60% of BOP OEM respondents indicate a CMMS or similar computer system is used to manage BOP maintenance. The results in Figure 4-14 indicate that these systems are past the initial implementation, but may be relatively new as compared to some industries.

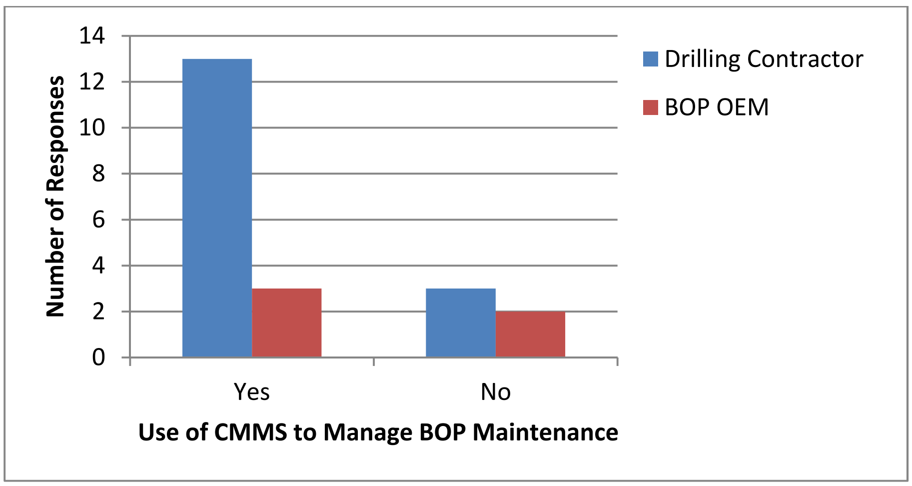

Figure 4-13. CMMS Used in BOP Maintenance

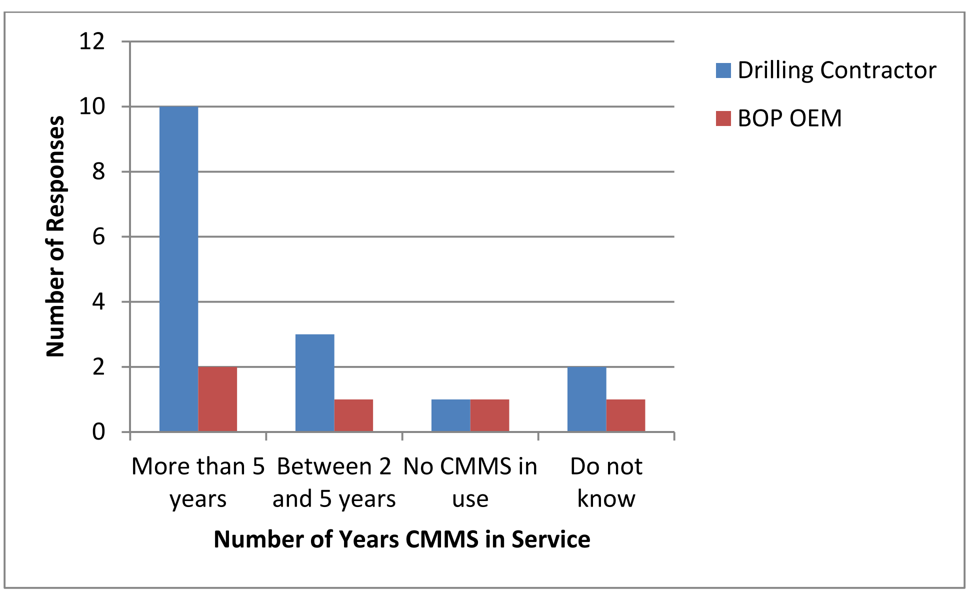

Figure 4-14. CMMS In-Service Time

The next inquiry involved the CMMS functionality employed in the management of BOP maintenance and types of overall management activities in which the CMMS is used. Figure 4-15 shows the CMMS functionality in use, and these results indicate core CMMS functionalities related to asset register, asset criticality, and maintenance work process activities (e.g., work order management, PM) are in use by both drilling contractors and BOP OEMs. To lesser extent, the CMMS appears to be used for procurement, stores inventory and document management activities. The notable areas in which the CMMS use could improve are related to continuous improvement type of activities, such as PM optimization, failure tracking, and reliability analyses.

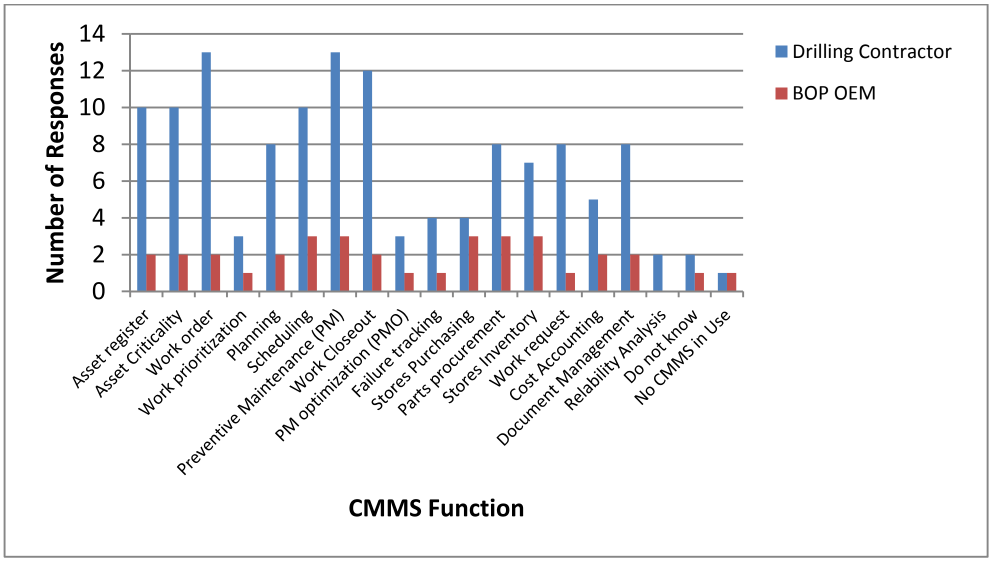

Figure 4-15. CMMS Functionality Employed

From the management activity perspective, the results in Figure 4-16 indicate the drilling contractors use the CMMS for cost and regulatory management activities. From a reliability improvement perspective, increase in the apparent CMMS use of stores inventory management, reliability analysis and key performance indicator generation and monitoring would likely aided in ensuring and improving BOP reliability performance.

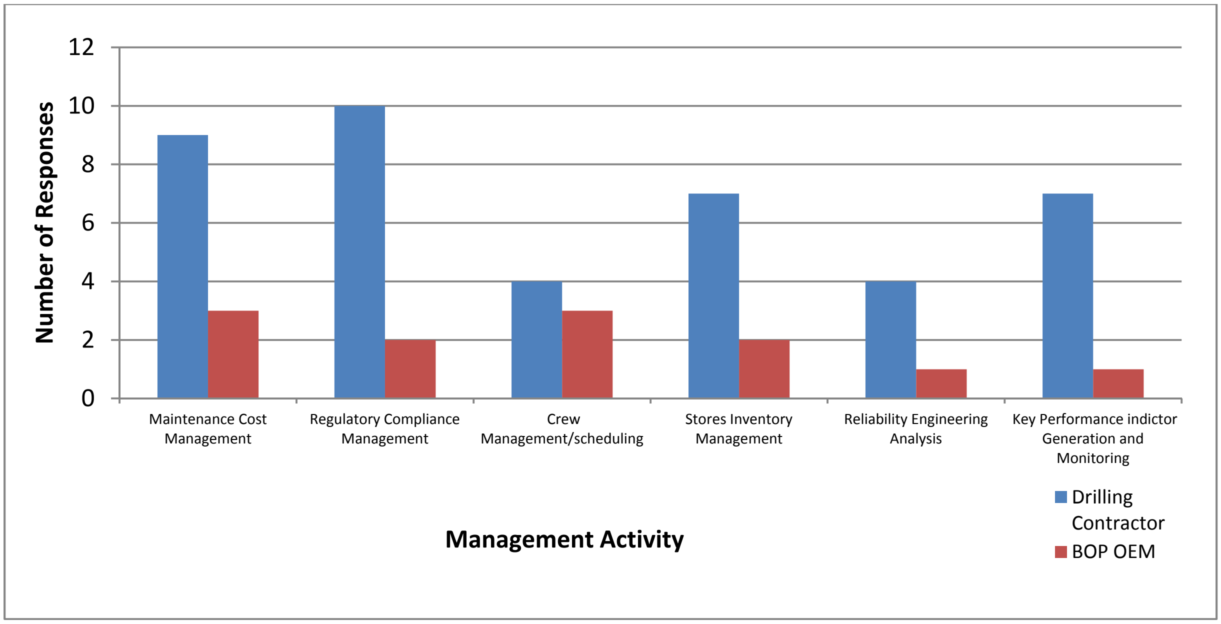

Figure 4-16. CMMS Management Activities

4.3.4 Maintenance Management Practice Results

Somewhat related to CMMS use, the next area surveyed related to the maintenance management practices in place. Specifically, the survey inquired about the formality of the maintenance management work process and adherence to the process, the work process elements included, the performance of key work process elements, and the monitoring of the work process. Figure 4-17 provides the results related to the formality and adherence to the work process. This figure indicates the drilling contractors have a formal process. However, BOP OEM respondents did not provide as strong of an indication of a formal process. In terms of adherence to the formal process (i.e., following the maintenance work process), fifty percent of the drilling contractors indicate formal process is not followed. This is not unusual in the maintenance practice surveys, and it is usually an indication that re-engineering of maintenance work processes may be needed. This is especially important because the maintenance work process is one of the most important management systems for ensuring proactive MIT activities are executed as planned and corrective maintenance is properly performed in a timely manner.

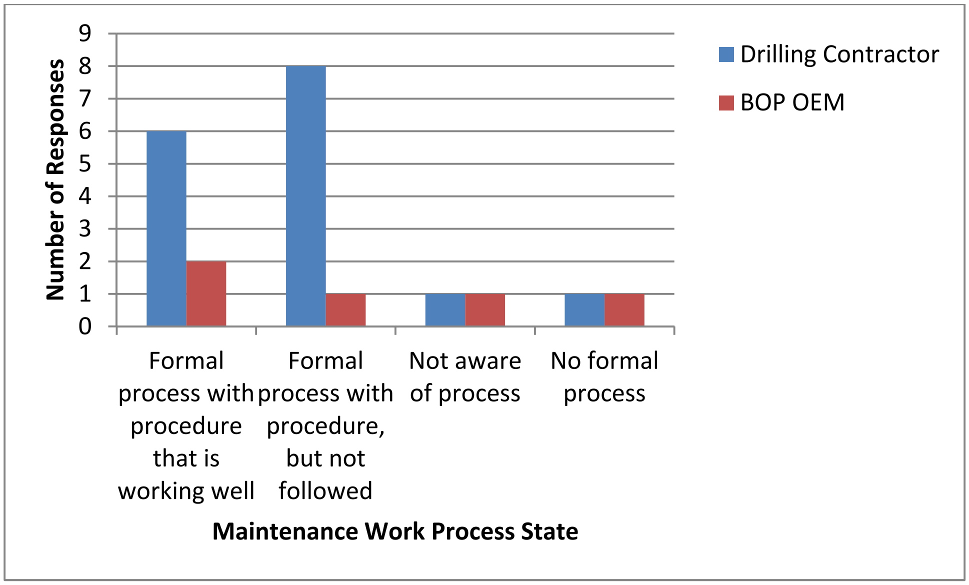

Figure 4-17. Maintenance Work Process

Next the elements included in the maintenance work process procedure were surveyed, and these results are presented in Figure 4-18. As with the CMMS, these results indicate the basic maintenance work control elements are included in the procedure.

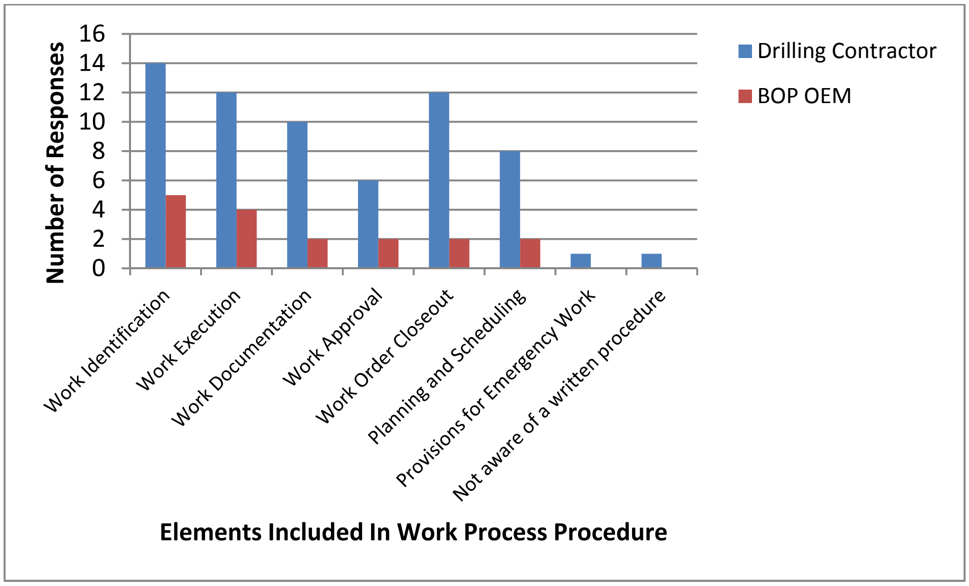

Figure 4-18. Work Process Elements

The next areas surveyed related to key work process elements – work order use, work prioritization, and work planning. Figure 4-19 provides the work order usage results, which indicates a high percentage of maintenance work performed is managed by work orders. However, the most frequent response was frequently, 75% to 95%, which is good performance, but is below want many industries consider best practice, >95%. In terms of work prioritization, the responses provide in Figure 4-20 indicate the priorities are jointly set by operations and maintenance personnel during work scheduling. This is seen as a good practice in many industries.

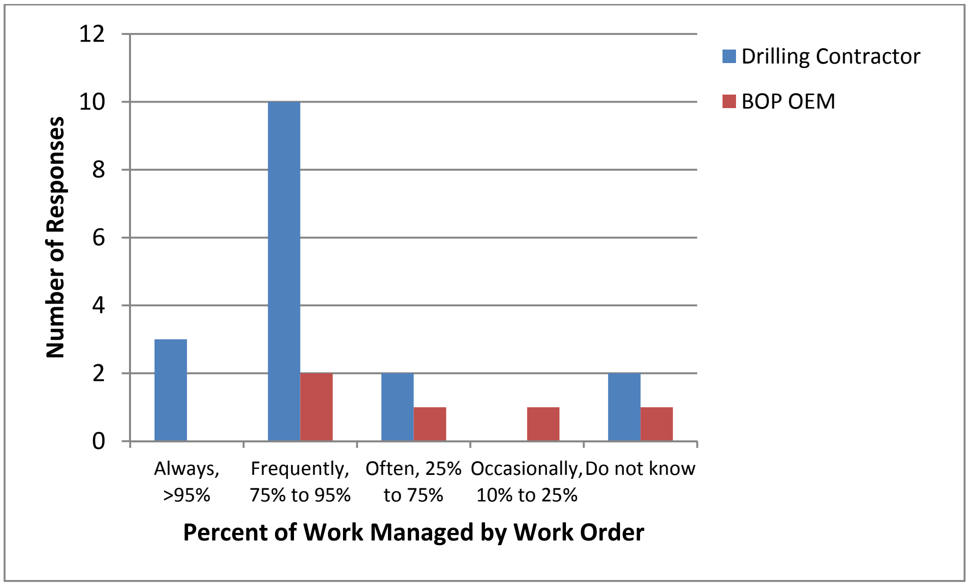

Figure 4-19. Work Order Use

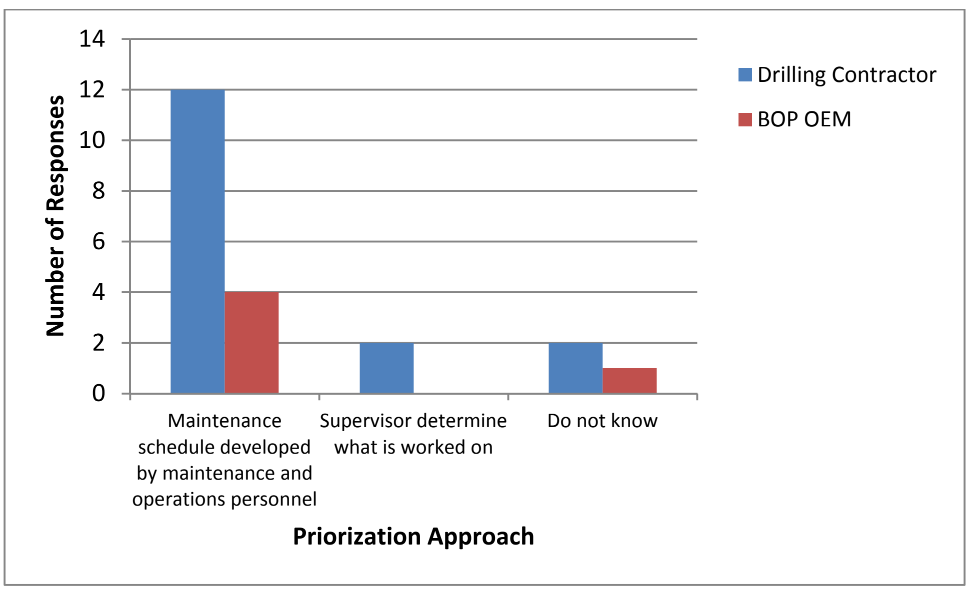

Figure 4-20. Work Prioritization

Figure 4-21 provides the responses related to work planning, and it shows that for drilling contractors a high percentage of time BOP maintenance work is planned. The BOP OEM respondents indicate less work planning is employed.

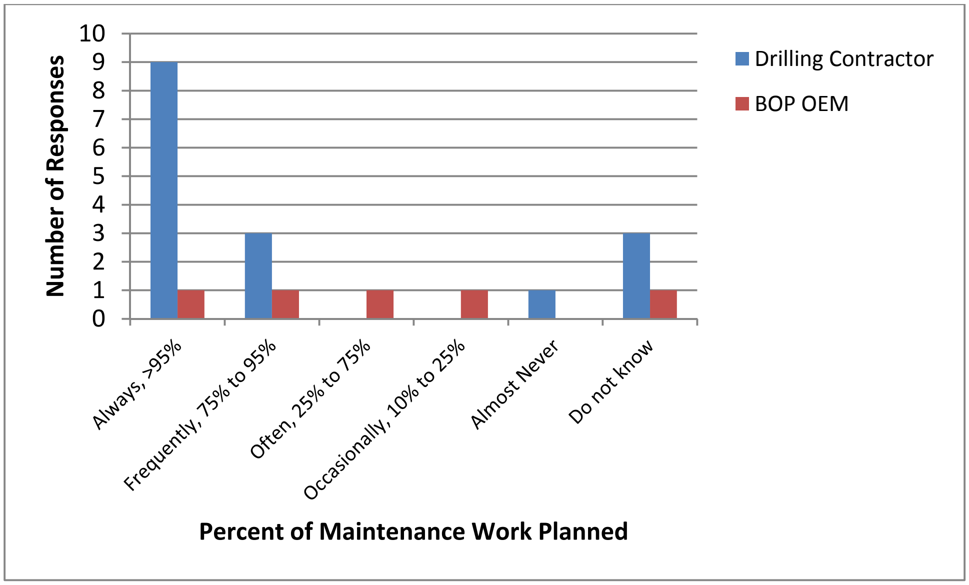

Figure 4-21. Maintenance Planning

The last work process element surveyed related to work results documentation. Figure 4-22 provides these results. These results indicate that drilling contractor documentation practices may not ensure proper recording of information, as 7 of the 16 responses indicate results are documented by indicating work order complete or recording equipment is okay (for PM results). In general, a good maintenance practice involves the recording more information about the work performed and equipment condition (for PMs). Eighty percent of the BOP OEM respondents indicate good documentation practices.

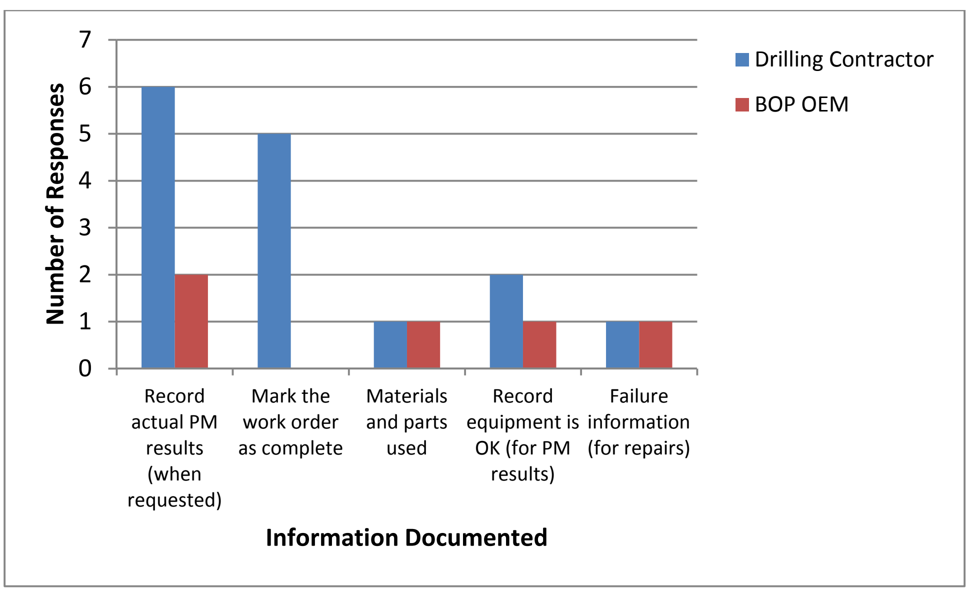

Figure 4-22. Work Results Documentation

The final area of inquiry related to monitoring of the maintenance work process performance, and Figure 4-23 contains these results. These results indicate the most common practice is routine work backlog review, which is the common practice in most industries. However, some respondents indicated audits and work management key performance indicators as approaches used. The use of work process key performance indicators is viewed as good practice in many industries, and the expanded use of this type of tool would likely help ensure and improve BOP reliability performance.

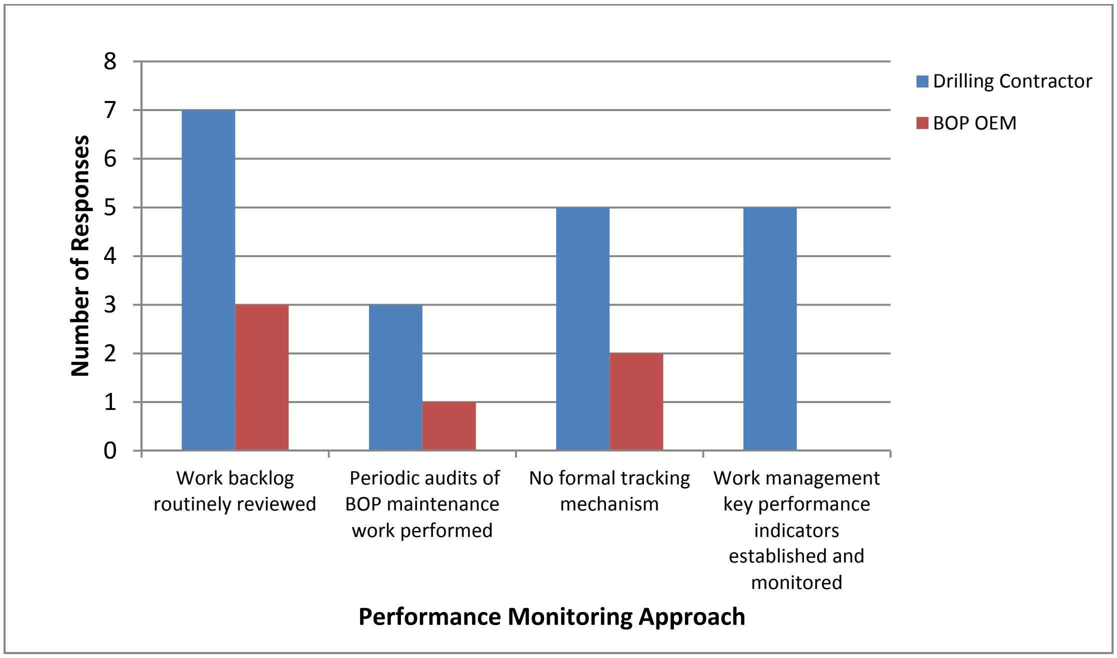

Figure 4-23. Maintenance Work Process Monitoring

4.3.5 PM Program Results

The next area surveyed involved attributes of the PM program. Specifically, the survey inquired about two areas of the PM program: (1) the approach for PM task periodicity and (2) the part replacement philosophy for BOP equipment. Figure 4-24 provides the survey results related to the basis for PM task periodicity (i.e., task intervals). These results show, as expected from the planned MIT task review presented in this report, a high dependence on BOP OEM recommendations. These results also seem to indicate BOP OEMs rely on their equipment vendors for PM task intervals.

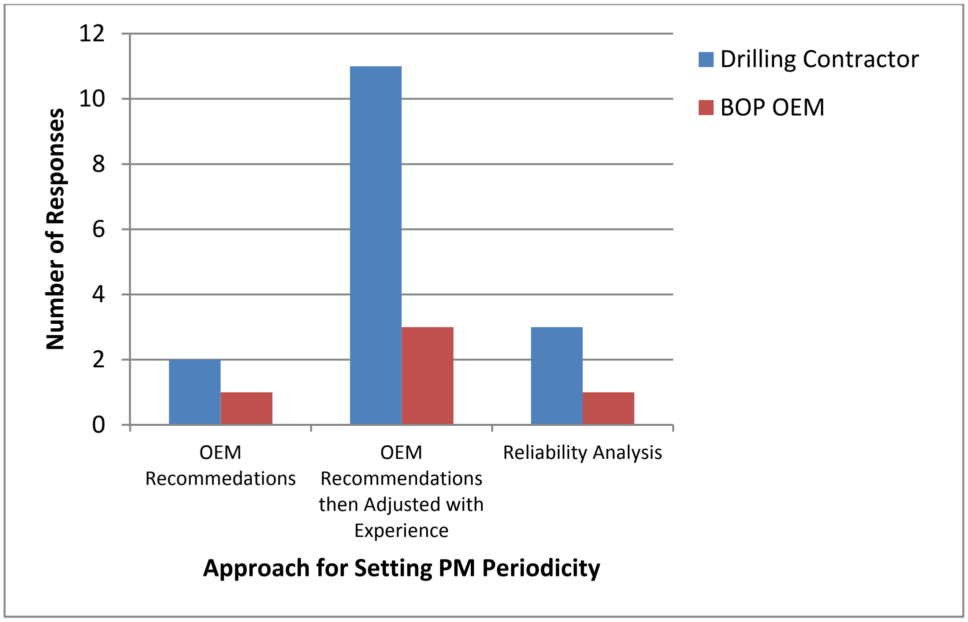

Figure 4-24. PM Task Periodicity Bases

The type of PM task intervals used by drilling contractors were surveyed, see Figure 4-25, and these results indicate calendar-based PM intervals are most frequently used while the BOP OEMs appear to set PM task intervals by a variety techniques. The final PM task interval question related to the review of PM task intervals. These results are provided in Figure 4-26 and indicate the most frequent response is that PM task intervals are regularly reviewed, which is a good practice for helping to improve maintenance effectiveness and BOP reliability performance.

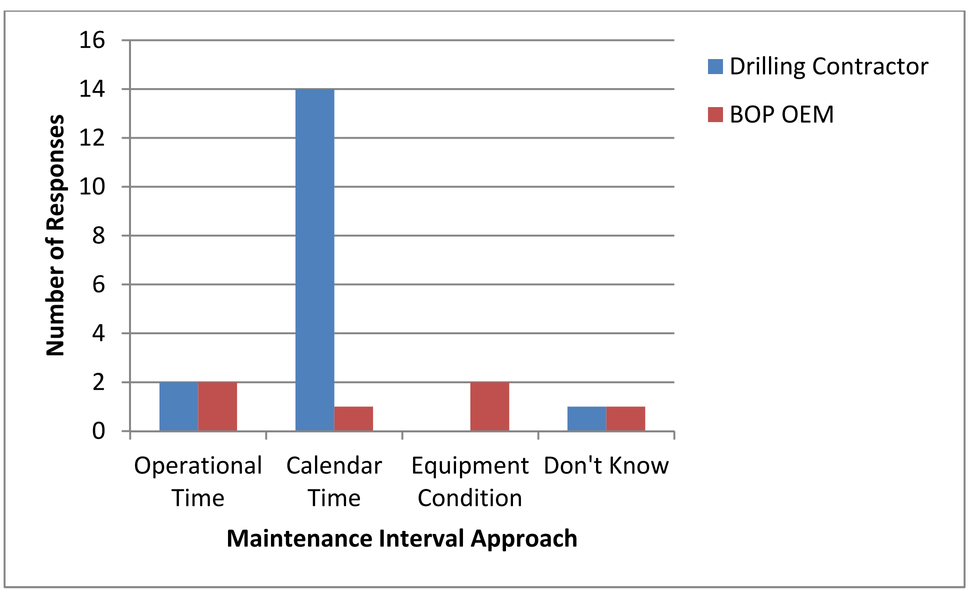

Figure 4-25. Type of PM Task Intervals

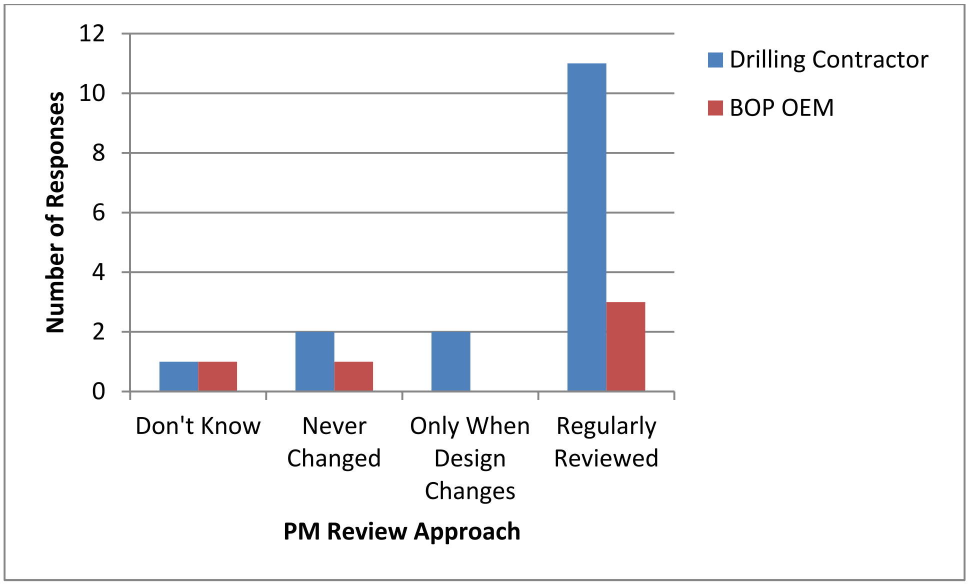

Figure 4-26. PM Review

The last area surveyed related to the part replacement philosophy for surface and subsea BOP equipment. This question relates which of the following philosophies are being used: run-to-failure, time-based, or condition-based. Figures 4-27 and 4-28 contain the results for parts replacement philosophy for subsea equipment and surface equipment respectively. Both results indicate a time-based approach (i.e., schedule calendar intervals) is used by the drilling contractors and BOP OEMs. However, condition- based approach appears to have some use for surface equipment. More use of a condition-based approach could improve BOP reliability performance if an effective approach can be designed, based on history in other industries.

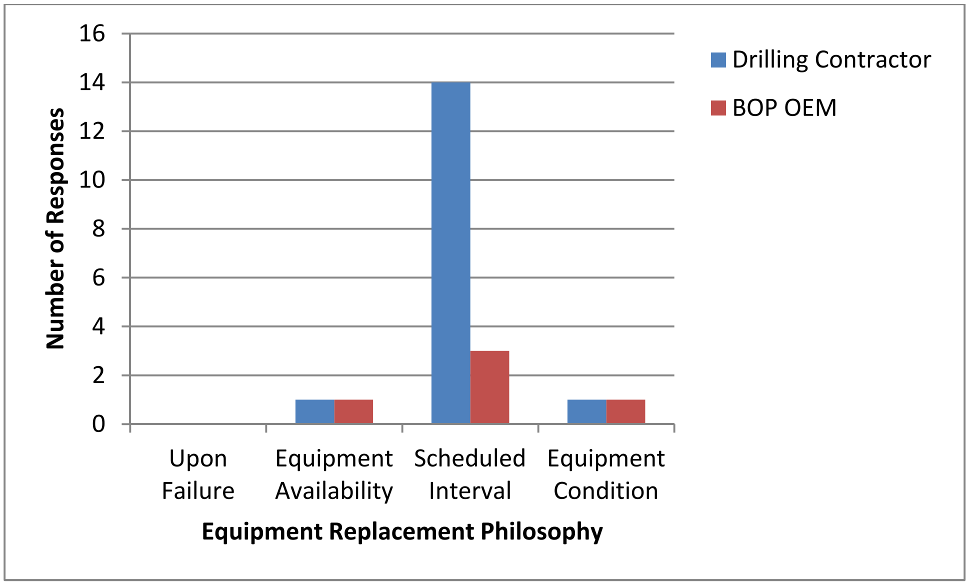

Figure 4-27. Subsea BOP Equipment Replacement Philosophy

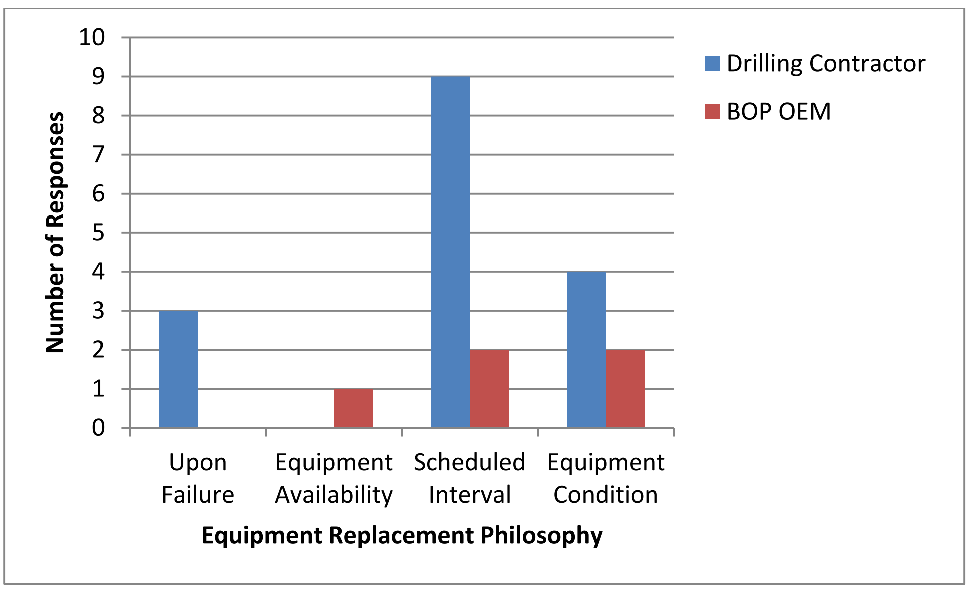

Figure 4-28. Surface BOP Equipment Replacement Philosophy

4.3.6 *Written Instructions Results*

This area of survey inquired about the written instructions and information provided to personnel who maintain the BOPs (BOP maintainers). The survey inquired about the type of instructions and information provided, its accessibility, the expected and actual use of the instructions, the content of written instructions, and the measures used to ensure and maintain accurate written instructions and information. The first area of inquiry involved the type of written instructions and how the BOP maintainers access the written instructions/information. These results are provided in Figures 4-29 and 4-30. Figure 4-29 indicates the high dependence on BOP OEM manuals and work order descriptions (vs. site/unit specific step-by-step instructions). Based on the results in presented in Figure 4-30, electronic access or transmission with the work order are used to provide BOP maintainers access to the written instructions/information. These accessible approaches have advantages in that they are electronic based which provides a better means for ensuring the most up-to-date information is provided BOP maintainers.

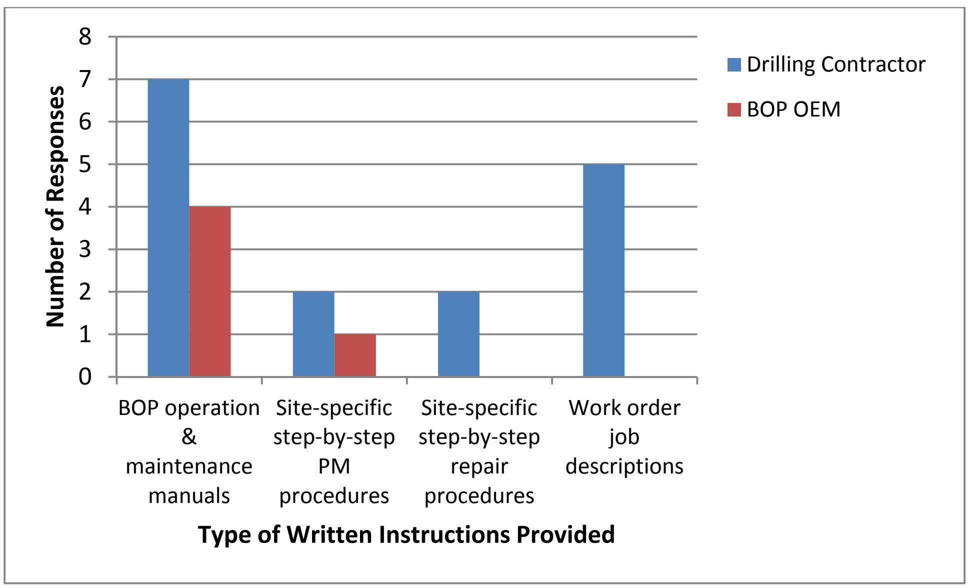

Figure 4-29. Type of Written Instructions/Information

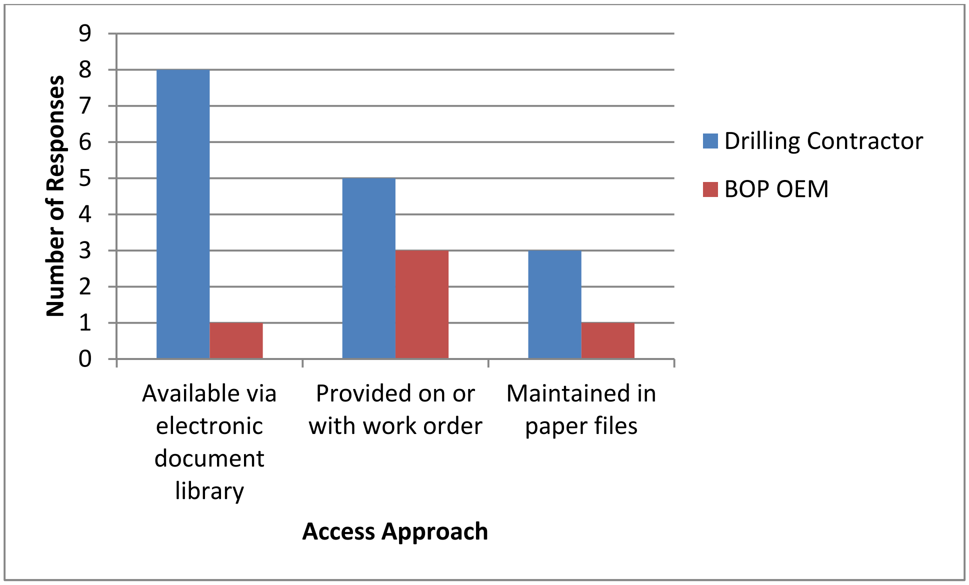

Figure 4-30. Written Instruction/Information Accessibility

The survey inquired by the content of typical written instructions. Specifically, this inquiry involved the content of repair instructions. (Note: Routine PM tasks are often detailed in OEM manuals and/or work order information; therefore, the inquiry regarding repair procedure instruction was selected.) Figure 4-31 contains the survey results regarding repair instruction content, and it shows nearly half of the drilling contractors indicated step-by-step instructions are provided, which is a good practice. However, slightly more than half of the drilling contractor respondents and majority of BOP OEM respondents indicated limited information is directly provided in the written repair instructions.

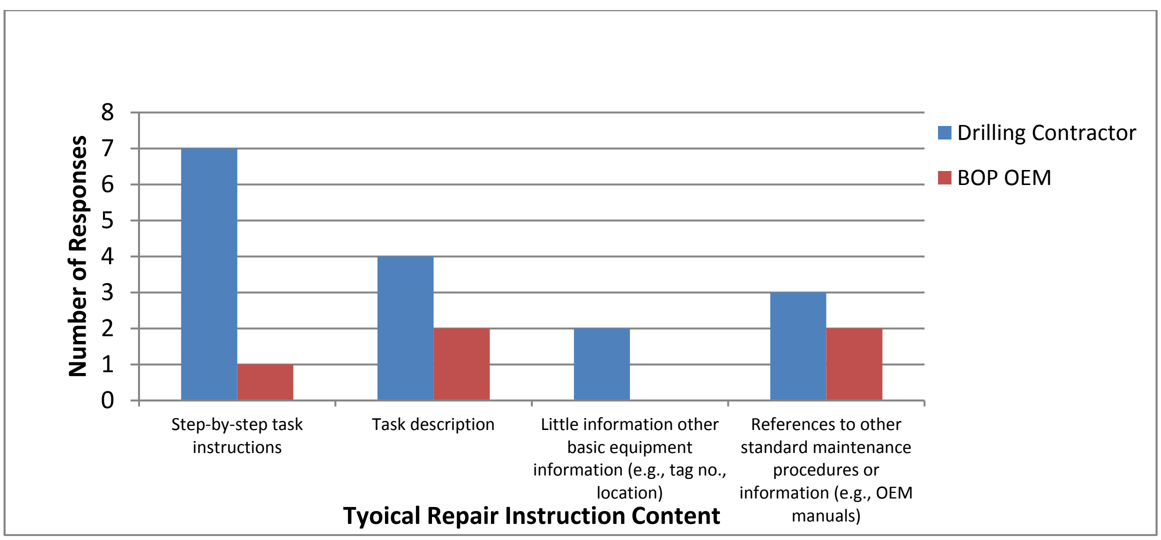

Figure 4-31. Typical Repair Instruction Content

There can be differing expectations on use of the written instructions, such as written instructions are primarily used as (1) a training tool,(2) a reference/guideline for performing a task, or (3) the expected means for performing a task. Figure 4-32 provides the data related to expected use of written instructions, and indicates mixed results in that some respondents view the written instructions as providing the expected way to perform tasks and other respondents view the written instructions as a guideline. While this is not usual, the most effective use of written instructions involves establishing procedures and clear expectations that the written instructions provide the expected steps for performing a task.

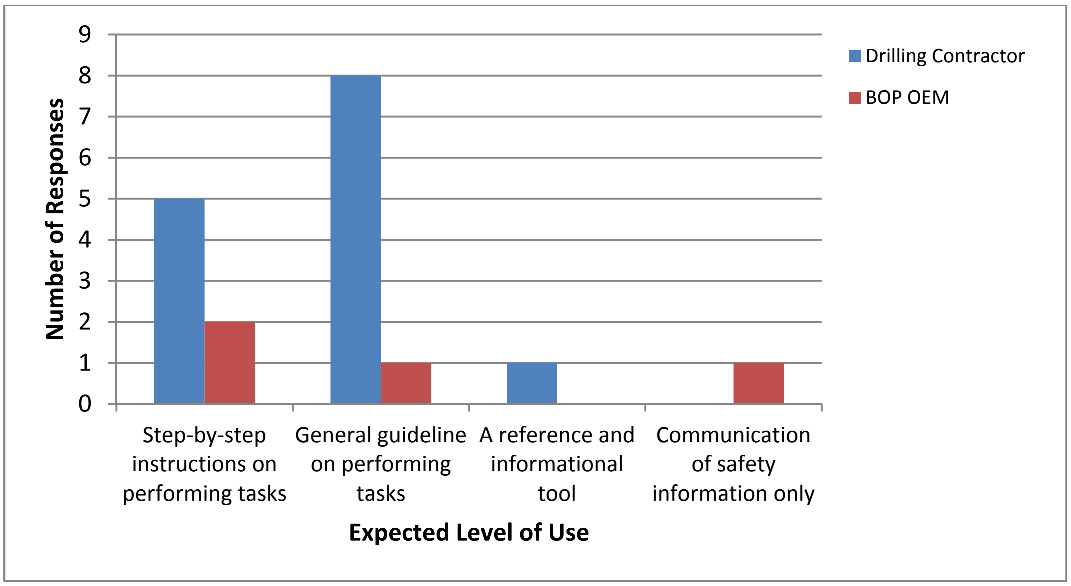

Figure 4-32. Expected Level of Use of Written Instructions

The next survey question inquired about the field use of the written instructions. Specifically, the question inquired how often the written procedures are typically used and when they are used during task performance. The results in Figure 4-33 indicate that the majority of drilling contractor and BOP OEM respondents indicate written instructions are usually reviewed/read either before or during the performance of a task. In addition, more than 50% of drilling contractor respondents indicated procedures are used during the performance of a task.

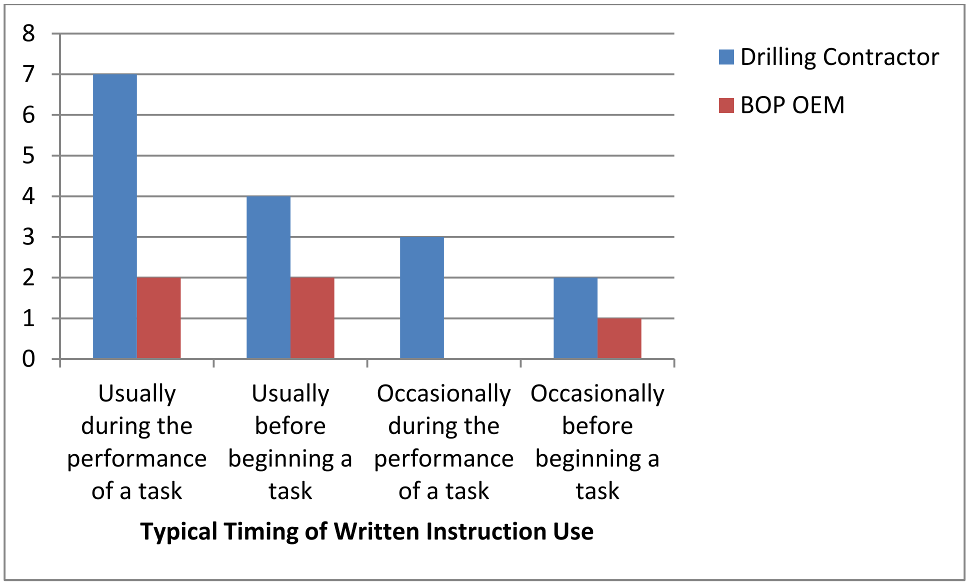

Figure 4-33. Written Instruction Use

The last two written instruction survey questions address systems in place to help ensure and maintain the accuracy of the written instructions. Figure 4-34 shows that a formal procedure review and approval with field validation is the most frequent approach used by drilling contractors. In addition, there were two responses by both drilling contractor and BOP OEM respondents indicating a formal procedure review and approval process is used. So nearly half of the respondents indicate a formal procedure review and approval process (with of without field validation) is used. However, nearly half of the other respondents indicated that there was no formal procedure review and approval process or relied on knowledge personnel to develop the written instructions. An improved practice would be to ensure all written instructions are reviewed and approved via a formal process, with the process including field validation when possible.

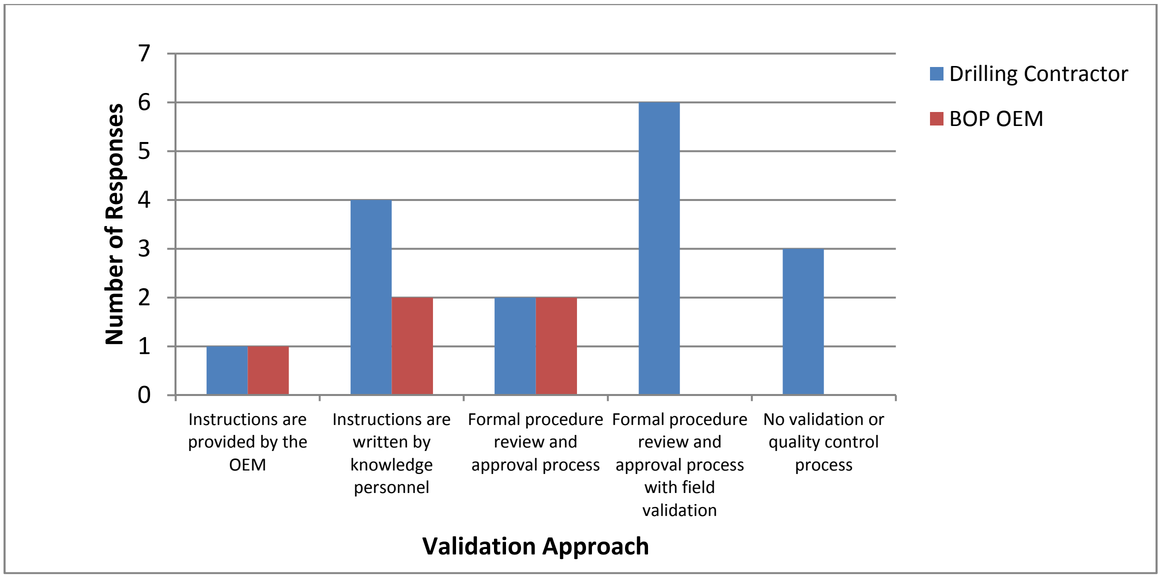

Figure 4-34. Written Instruction Validation

Figure 4-35 provides the results related to process used for controlling and maintaining written instructions. These results indicate BOP OEMs have some form of a document control standard and system in place. Also, a little more than one half of the drilling contractor respondents indicated an existence and use of some form of a document control standard and system.

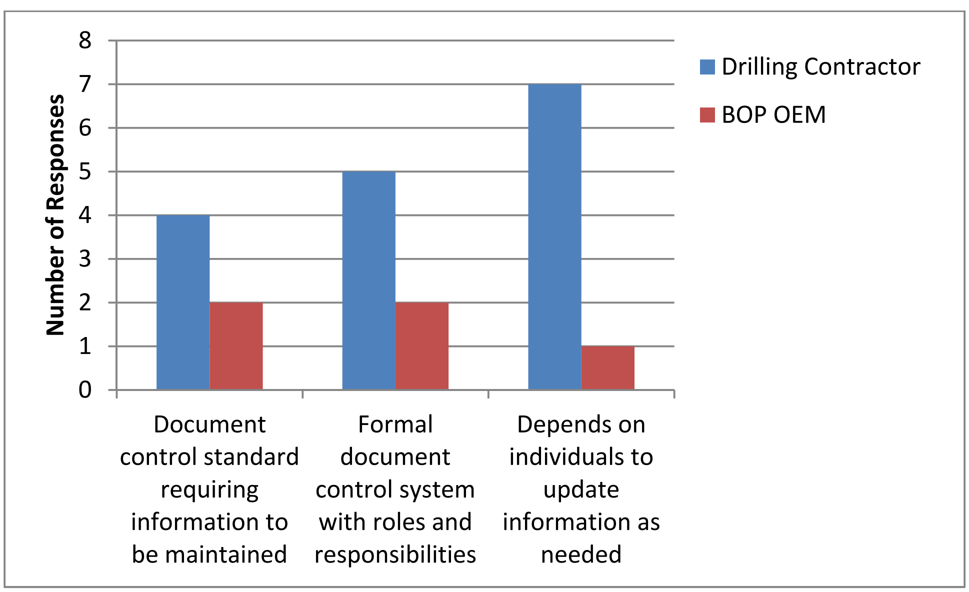

Figure 4-35. Written Instructions Control

4.3.7 *Training Results*

The last survey area involved the training programs in place for personnel who maintain BOPs (i.e., BOP maintainers). The survey addressed the type of training techniques used, the timing of training, and the general content of training. Figure 4-36 indicates both drilling contractors and BOP OEMs rely on previous work experience and also provide informal, on-the-job training, and formal training (e.g., classroom training).

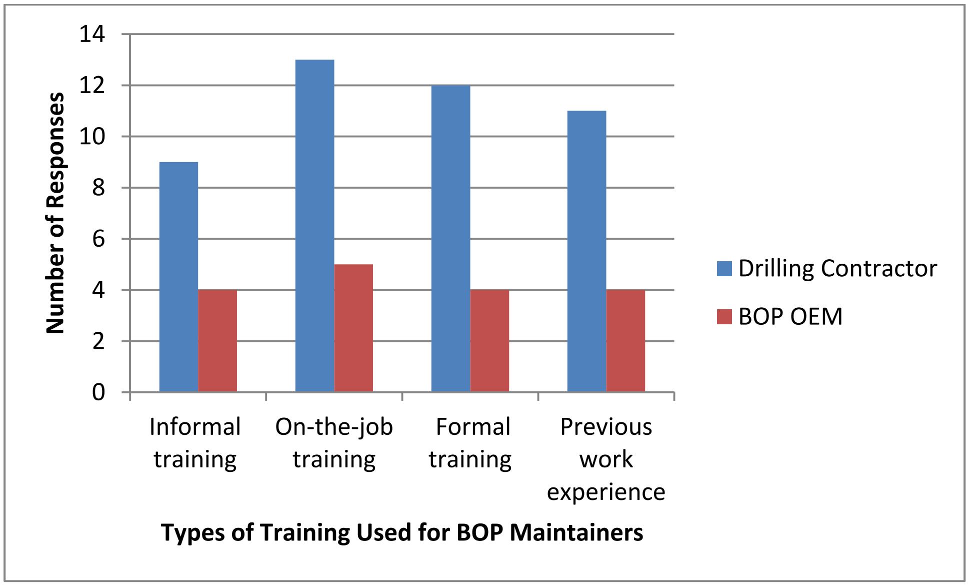

Figure 4-36. BOP Training Approaches

Figures 4-37 and 4-38 provide the survey results related to when training is provided and the content of the training. As seen in Figure 4-37, nearly all of the respondents indicate BOP maintainers receive training when they are assigned to their position. However, these results appear to indicate that a limited amount of refresher and periodic training is provided. Most of the drilling contractor and BOP OEM responses in Figure 4-38 indicate basic craft skill training, general BOP operations and maintenance training, and safety type training are provided. However, the responses seem to indicate training on BOP PM and repair procedures and maintenance policies and procedures may be less common.

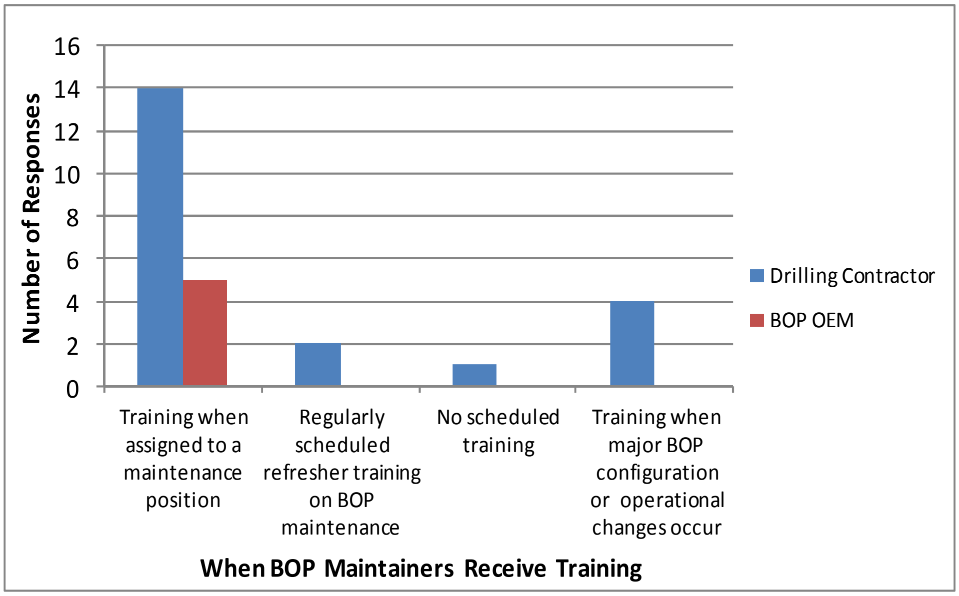

Figure 4-37. BOP Training Timing

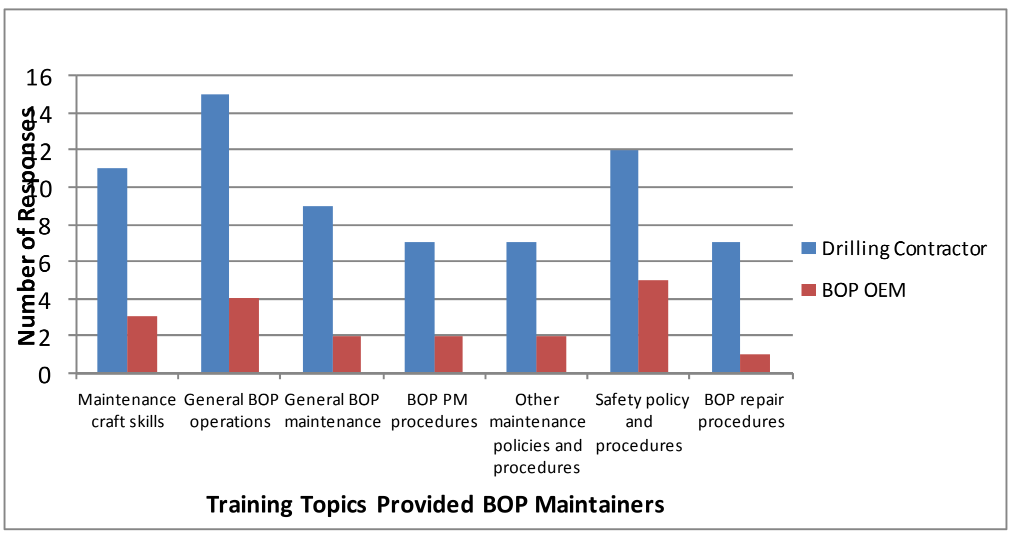

Figure 4-38. BOP Training Content

5.0 MIT ACTIVITIES COMPARISON

The section provides a comparison of the MIT activities collected from the various sources included in this project (e.g., regulations, industry standards and recommended practices, IP MIT plans). The initial comparison focuses on comparing API 53 and 30 CFR 250 with the other regulations reviewed. In addition, this section compares (at a high-level) the MIT activities identified in the regulations and industry standards and recommended practices to the MIT activities currently employed by IPs operating BOPs in the GoM.

5.1 REGULATORY AND INDUSTRY STANDARD AND RECOMMENDED PRACTICE COMPARISON

Section 2 of this report provides a tabular summary and comparison of the API 53 and 30 CFR 250 MIT requirements to the MIT requirements included in selected industry standards and recommended practices, and international regulations. In general, 30 CFR 250 and most of the other international regulations incorporate and reference MIT requirements included in API 53. The following are the exceptions/differences found when comparing MIT requirements:

- Higher frequency of Operational Components Function Test (Blowout Prevention in California)
- Higher frequency of BOP Control System Function Test (Blowout Prevention in California)
- Higher frequency of Accumulator Pressure Precharge Verification (Blowout Prevention in California)
- Higher frequency of BOP Visual Inspection (30 CFR 250)
- Higher frequency of visual inspection of Subsea BOP System and Marine Riser (Blowout Prevention in California)

One other notable difference is some international regulations (e.g., Norsok D-010 specifies that that the well testing activity starts after having drilled the last open hole section) allow or require MIT requirements to be more based on performance or risk-based approaches rather than the mostly perspective approach seen in API 53 and 30 CFR 250.

5.2 IP MIT PLAN AND API 53 COMPARISON

As indicated in the above section, API 53 MIT requirements are incorporated in most all regulations and other industry standard; therefore, the IP MIT plans (i.e., tables included in Appendix B) were compared to the specific MIT requirements in API 53. (Note: API 53 includes a requirement to implement a PM program based on OEM requirements. This recommendations was not included in this comparison).

This comparison indicated that all of the prescriptive API 53 requirements are included in the IP MIT plans included Appendix B at the API 53-indicated interval. In addition, the analysis included a comparison of the percent of API 53 tasks to the overall planned MIT tasks. This included a comparison to the number of specified tasks (i.e., simple count of MIT tasks by task type), and these results are provided in Figure 5-1. This figure indicates API 53 tasks comprise between 10 to 18% of planned maintenance, scheduled inspection, and scheduled test tasks included IPs MIT plans (based on simple count of number of tasks). This comparison shows the planned MIT tasks include an appreciable more number of MIT tasks than required by API 53.

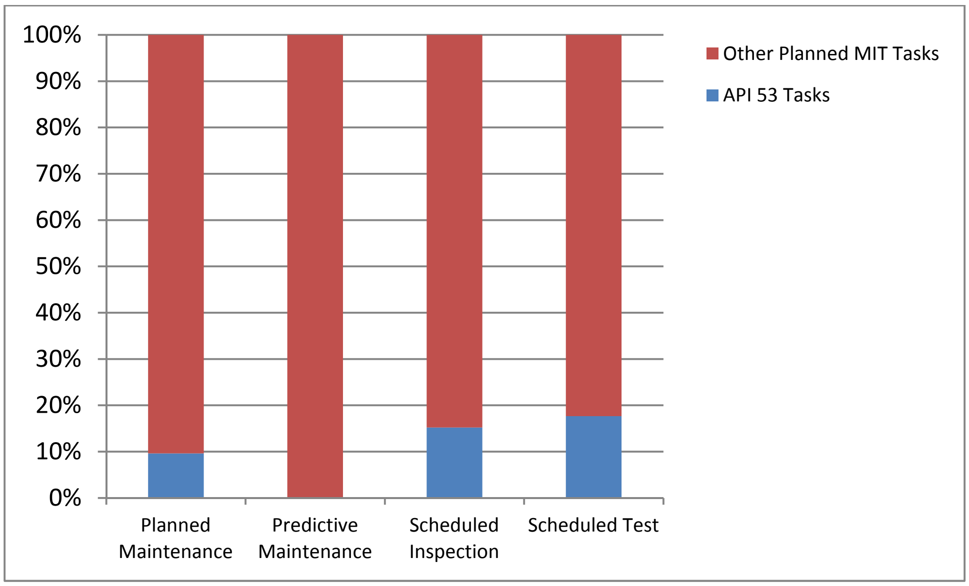

Figure 5-1. Percent of API 53 Tasks Specified of Total Count of Planned MIT Tasks

To compare the percentage to performed tasks, the analysis included an estimation of the number of MIT tasks executed during a one year time period based on a six 8-week drilling programs over one year. Figure 5-2 contains an estimation of percent of API 53 required tasks performed as compared to the performance of all of the planned MIT tasks during the year. This figure shows a similar trend as Figure 5-1 except the percentages are even lower. Again, an indication IPs MIT plans include MIT tasks significantly beyond what is required by API 53.

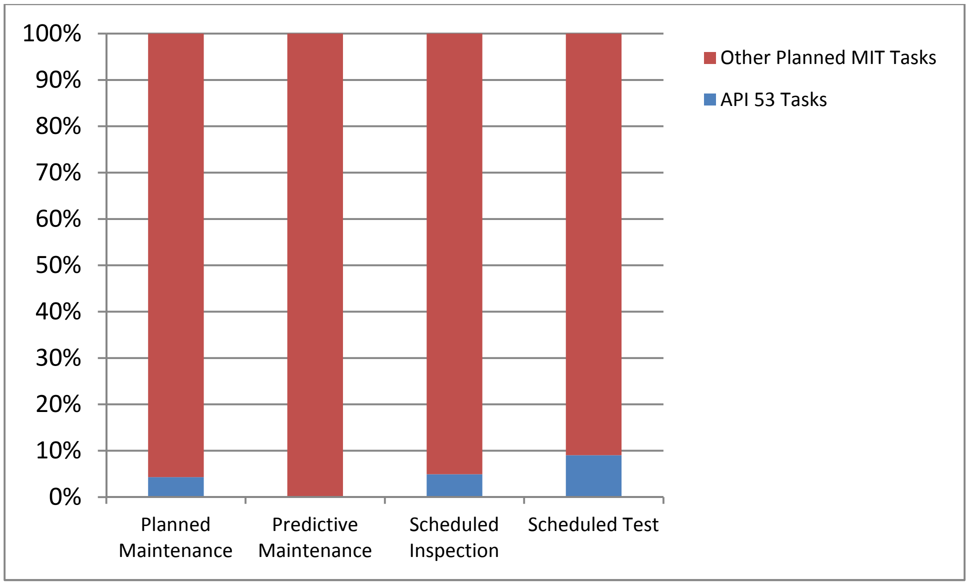

Figure 5-2. Estimated Percent of API 53 Tasks Performed of Total Number of Planned MIT Tasks Performed

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6.0 CONCLUDING REMARKS

This report summarizes three aspects of the BOP MIT practices: (1) the MIT requirements included in regulations and industry standards, (2) the typical planned MIT tasks employed by the IPs participating in this project, and (3) the results of maintenance and reliability management practices survey. Each aspect provides unique information regarding BOP MIT practices and insights into some potential MIT improvement opportunities. This section summarizes each report section and any related findings.

6.1 MIT ACTIVITIES – REGULATIONS AND INDUSTRY STANDARDS AND RECOMMENDED PRACTICES

As expected, this effort clearly indicates API 53 is the key document for defining the BOP MIT requirements. API 53 provides a rather comprehensive approach and includes references to OEM PM program requirements. One observation from this review is:

- The application of performance- and/or risk-based maintenance approaches (versus adoption of OEM PM requirements) may result in improved BOP reliability performance with less maintenance. This trend is been seen in other industries.

6.2 MIT ACTIVITIES – IP MIT PLANS AND OEM IOM MANUALS

These results indicate an extensive set of MIT activities are included in IP MIT plans and the OEM IOM manuals. In addition, these planned MIT activities include many more activities than required by API 53 MIT requirements. As discussed in Section 5 of this report, the planned MIT activities involve approximately nine fold increase over the API 53 required MIT. In addition, many of these requirements appear to be based on information in OEM IOM manuals. Two observations from this effort are:

- The use of predictive maintenance techniques to maintain BOP equipment is very limited.
- Much of the planned MIT activities are prescriptive time- based activities included in OEM IOM manuals rather than tasks based on a performance, or a risk or reliability analysis.

6.3 MIT MANAGEMENT SYSTEM SURVEY

The MIT management system survey indicated the presence of good maintenance management practices in many of areas surveyed. All management system areas surveyed indicated some good practices were in place. In addition, the survey results generated the following observations:

Failure Elimination

- BOP failure identification and documentation and formal investigation processes appear to be in place and functioning.
- Based on the limited number of responses related to trending of repeat failures, there does not appear to be a practice of trending of failures and reviewing the trend for repeat failures and thus the potential need for investigation and corrective action.
- Several survey respondents indicated there was no formal corrective action tracking system, which is a key system to ensuring corrective actions are implemented in a timely manner.

CMMS

- In general, it appears that the core CMMS elements are being used by most IPs to manage BOP maintenance.
- CMMS functionality, such as PM optimization, failure tracking, and reliability analyses appear to be in less use. These functionalities can used to help improve BOP reliability performance once implemented.
- Similarly, as for management activities, CMMS is appears to being used less for stores inventory management, reliability analysis, and key performance indicator generation and monitoring. Further implementation of these activities may also help improve and sustain BOP reliability performance.

Maintenance Management Systems

- The survey responses indicate a good number of the maintenance management systems, relative to the core maintenance work process (e.g., work order use, work prioritization), are in place and functioning.
- The survey responses seem to indicate that the results from maintenance work activities (e.g., PM results, repair actions) may not be consistently recorded. Complete documentation of work activities provides the information needed for continuous improvement efforts, such as PM optimization and reliability analyses.
- Key performance indicators do not appear to be widely used to monitor and improvement maintenance activities and maintenance management performance.

PM Program

- As stated above, extensive PM programs have been established for BOP and most of the PM intervals based on calendar time, which results from API 53 requirements and/or maintenance practices in OEM IOM manuals.

- There is a high dependence on OEM IOM manual recommendations for PM task intervals versus more performance and analytical approaches, such as reliability-centered maintenance analyses.
- The PM intervals are almost all based on calendar time rather than equipment condition.

Written Instructions

- The survey indicates written instructions of varying types are provided and are readily available to BOP maintainers. In addition, most respondents indicated some form of a document control system was in place to help ensure written instructions are maintained.
- The survey provided mixed feedback on the expected use of written instructions. About half respondents indicated written instructions should be used as step-by-step instructions for performing a task and about an equal number of respondents viewed written instructions as a general guideline for performing a task.
- Slightly more than of the survey responses indicated repair procedures tend to contain limited information (i.e., step-by-step instruction were not provided).

Training

- The survey responses indicated training programs are in place for BOP maintainers, and the training is provided when personnel are assigned to a job involving BOP maintenance.
- The survey results indicated that a limited amount of refresher and periodic training is provided to BOP maintainers.
- The training provided BOP maintainers appears to not always include training on BOP PM and repair procedures.

In closing, this report’s results show that BOP MIT activities are important to drilling industry and regulators, and the drilling contractors and BOP OEMs have established MIT programs and management systems intended to proactively maintain BOPs.

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APPENDIX A – BOP SYSTEM HIERARCHY AND DEFINITIONS

Table A-1: BOP System Hierarchy and Definitions

<table>
<tr><td colspan="2"><u>Surface Control System:</u> The purpose of the BOP control system is to provide a means to individually actuate components in the BOP stack by providing pressurized hydraulic fluid to the selected stack components.

Consists of Electric Power Supply, Uninterrupted Power Source (UPS), Hydraulic Power Unit (HPU), Human to Machine Interface (HMI), MCC and I/O modules to process, communicate and display command and status data.</td></tr>
<tr><td>HPU</td><td>Monitors, mixes, store hydraulic fluid and generate pressurized hydraulic fluid for BOP system control usage. Directs the hydraulic fluid via regulators and manifolds to various BOP functions and surface accumulators.
Mixing system
Storage tanks, pumps and associated pipes & manifolds to mix storage tank contents with a fresh water supply and store in a mixing tank with level indicators and mixing pump.
HPU
Creates and monitors hydraulic operating pressure inclusive of distribution piping, hydraulic pumps with associated electric motors, suction strainers, high pressure discharge filters, check and isolation valves in discharge manifold, hydraulic manifolds supplying to accumulator banks, rigid conduit and hose reels inclusive of isolation & relief valves.</td></tr>
<tr><td>Electrical Power</td><td>Uninterruptible power supply, blue & yellow UPS, inclusive of independent control and distribution, battery - charged from primary generators or emergency generator, power distribution panels, power isolation junction box (J-box) providing isolation and/or cross-feed of UPS output, distribution panel distributing power to the various MUX control system, umbilical J-box providing control voltage to subsea functions.</td></tr>
<tr><td>MUX Control System</td><td>Subsea multiplex system (MUX) BOP control systems provide electrical power, control signal, hydraulic power and communication to various BOP function.

Central Command Center/Unit (CCC/CCU)
The primary processor to interpret and communicate control functions to and from subsea control pods by means of:
– Processing array's for communication and distribution
– Power distribution and communication to associated equipment
– Flash drives: pre-programmed hard disk drives with processing software programmed by the OEM
– Climate-controlled purged cabinets.
MUX Reels Spools for mux cable inclusive of; drive motors, level winds, brakes and control panels. The MUX electrical cable supplies power and communications for control of the subsea control pods. The MUX cable is run, retrieved, and stored on a cable reel.
Slip Rings fiber optic and electrical to provide communication during rotation.</td></tr>
</table>

Table A-1: BOP System Hierarchy and Definitions (cont'd)

Rigid Conduit & Hotline	Providing path for transfer of hydraulic fluid for subsea operations. **Pipes, tubes and/or flexible hoses (hotline, hydraulic hose, rigid piping and tubing)** The **hotline hose** supplies power fluid from the surface to the subsea control pods mounted on the LMRP. The hotline is run, retrieved, and stored on the hose reel. **Hydraulic Supply Line (Hard/Rigid Conduit)** An auxiliary hydraulic supply line, referred to as a hard or rigid conduit, is a line attached to riser joints. The purpose of this auxiliary line is to supply control fluid from the surface accumulator system to the control pods and subsea accumulators mounted on the BOP and/or LMRP assemblies. **Reels**: spools for hydraulic hoses inclusive of; drive motors, level winds, brakes and control panels. **Swivel**: providing hydraulic communication between supply and hose on the reel during rotation.
Surface Accumulators	Pressure vessel to store hydraulic energy with internal pressurized bladder (bag), charging valve, manifold and racks to mount and segregate multiple bottles, isolation valves, relief valves and check valves.
Control Panels	**3.1.24** **control station/panel, remote** A panel containing a series of controls that will operate the BOP functions from a location that is remote from the hydraulic control manifold or central processor in the case of a MUX or multiplex control system. Remote panels sending and receiving command and status signals to/from the **CCC/CCU, inclusive of:** – HMI: to input command signals (button or touch-screen) – Monitors – Indicator to display data – Processor nodes and/or cards – Flash drives (software programmed by OEM) – Sensors and alarms for control system & BOP status – Cabinet purge system with sensors and alarms – Includes TCP, DCP, Hydraulic control panel and local panels.

Table A-1: BOP System Hierarchy and Definitions (cont'd)

<u>Subsea Control System</u> Primarily located subsea on the LMRP, it receives hydraulic fluid and command signals from the HPU and CCC/CCU respectively to regulate and direct hydraulic fluid to designated control and function-operators. Provide interface with Emergency and Secondary Control System commands.	
Blue & Yellow Subsea Control System	**Control pod** An assembly of valves and regulators (either hydraulically or electrically operated) that when activated will direct hydraulic fluid through special apertures to operate the BOP equipment. Each control pod contains Subsea Electronic Module (SEM) Module, all necessary valves and regulators to operate the BOP stack and LMRP functions. Blue & Yellow pods, located on the Lower Marine Riser Pack (LMRP) to receive command signals and hydraulic fluid and convert it to regulated hydraulic signal. Also communicates status signals to and from CCC/CCU. The system includes the following components: • **SEM**: electronic modules to convert fiber-optic signal for input to solenoid valves and provide power distribution • **Compensated Chamber:** sealed di-electric fluid filled chamber containing electronic components compensated to outside hydrostatic pressure • **Solenoid valves**: receive electrical signal to operate Subsea Plate-mounted (SPM) valves. (Direct Drive Valves [DDVs] and Compensated Chamber Solenoid Valves [CCSVs]**)** • **SPM Valves:** three (3) way spool valves operated by a hydraulic pilot signal • **Hydraulic Manifold**: manifold block in which SPM valves are mounted. Provides supply pressure as well as, ambient vent and operate port for each valve • **Pilot Operated Valves (POCV and SSV)** : Pilot-operated directional valves • **Manual Pressure Regulator:** a component that permits attenuation of control system supply pressure to a satisfactory pressure level to operate components downstream and adjustable manually • **Remote Pressure Regulator**: a component that permits attenuation of control system supply pressure to a satisfactory pressure level to operate components downstream and adjustable remotely using pilot hydraulic supply • **Pilot and Supply Manifold Filters** A device to entrap physical contaminate of particular size in hydraulic fluid before it goes into system downstream • **Tubing**: pipes, tubes to direct hydraulic fluid to its designated operator function • **Shuttle Valves:** Two-position three-way valves installed on operating ports of Stack components. They provide communication between Yellow or Blue Control Pods and the associated • **Flexible hoses**: steel braided rubber hose between pods and shuttle valves, end device • **Pod Receptacles:** pod interface to LMRP and BOP receiver inclusive of packer seals seal subs and locks • **Pod Flow meters:** A device/component to measure fluid volume on blue & yellow pods • **MUX subsea**

Table A-1: BOP System Hierarchy and Definitions (cont'd)

LMRP-mounted Accumulators	LMRP-mounted, accumulators associated with specific functions
Emergency & Secondary Controls	Emergency control systems operated either automatically or by surface command; and Secondary control systems such as acoustic signal or via ROV intervention. • **Emergency Disconnect System (EDS):** The EDS is a programmed sequence of events that operates the functions to leave the stack and controls in a desired state and disconnect the LMRP from the lower stack. The number of sequences, timing, and functions of the EDS are specific to the rig, equipment, and location. • **Autoshear:** Autoshear is a safety system that is designed to automatically shut-in the wellbore in the event of a disconnect of the LMRP • **Deadman:** The deadman system is designed to automatically shut in the wellbore in the event of a simultaneous absence of hydraulic supply and control from both subsea control pods. • **Acoustic Control:** The acoustic control system is an optional secondary control system designed to operate designated BOP stack and LMRP functions and may be used when the primary control system is inoperable. • **ROV Operation:** the provision for ROV intervention to operate critical functions on subsea BOP stack. ROV intervention equipment that at a minimum allows the operation of the critical functions (each shear ram, one pipe ram, ram locks, and unlatching of the LMRP connector).
<u>Subsea BOP Stack</u> The complete assembly of subsea well control equipment, including various preventers, spools, valves, connectors and nipples connected to the top of the wellhead or wellhead assemblies. BOP Stack is to contain wellbore fluids either in the annular space between the casing and the tubulars or in an open hole during well drilling, completion, and testing operations.	
Annulars	A blowout preventer that uses a shaped elastomeric sealing element to seal the space between the tubular and the wellbore or an open hole.
Blind Shear Ram	Ram BOP whose ram blocks incorporate a cutting blade to shear the pipe and sealing elements to contain well bore pressure upon shearing of the pipe. A closing and sealing component in a ram blowout preventer that first shears certain tubulars in the wellbore and then seals off the bore or acts as a blind ram if there is no tubular in the wellbore.
Casing Shear Ram	Ram BOP whose ram blocks incorporate a cutting blade to cut casing and/or heavier grade tubulars within a specific range. They do not seal the well bore. A closing component in a ram blowout preventer that is capable of shearing or cutting certain tubulars.

Table A-1: BOP System Hierarchy and Definitions (cont'd)

Pipe & Test Rams	• **Pipe ram:** A closing and sealing component in a ram blowout preventer that seals around the outside diameter of a tubular in the wellbore • **Ram blowout preventer**: a blowout preventer that uses metal blocks with integral elastomer seals to seal off pressure on a wellbore with or without tubulars in the bore • **Fixed Pipe Ram**: closing and sealing component in a ram blowout preventer that is capable of sealing on a fixed tubular sizes • **Variable Pipe Ram**: closing and sealing component in a ram blowout preventer that is capable of sealing on a range of tubular sizes • **Test Ram**: A Variable Bore Ram located in the lower most ram cavity with ram block installed in inverted position to seal pressure from the top and enable testing of the BOP Stack without running a test tool.
C&K Valves and Lines	Valves and pipes assembly enabling communication to or from the well bore to the surface C&K manifold to circulate well, control kicks or kill a well. • **C&K Line:** a high-pressure line that allows fluids to be pumped into or removed from the well with the BOPs closed • **Subsea C&K Valves**: fail-safe gate valves enabling communication with the well bore. • **Bleed Valves**: fail-safe Valves located under the Upper most Annular to relieve trapped pressure/gas from the BOP stack upon completion of well control operations. • **C&K Line Test Valves**: fail-safe valves enabling test of the Choke and Kill Lines while running the BOP stack or LMRP • **Flanges and Spools**: devices incorporated in the C&K piping system, consists of spools (pipe with flanged connections), T-, L- and/or Y-blocks (machined blocks providing fluid communication between three flanges or ports and target and blind flanges used to close a flanged outlet of a BOP or redundant port of a three-way block • **Spacer Spool:** a spool used to provide separation between two components with equal sized end connections • **Flex Loop & Jumper Hoses**: pipe or hoses installed between C&K stabs of the LMRP and the fixed C&K connection to the riser to accommodate displacement of the flex joint • **Drape Hoses**: provide communication form C&K Stabs on the slip joint outer barrel and rigid pipe of the surface C&K System. They accommodate vertical and angular displacement of the rig

Table A-1: BOP System Hierarchy and Definitions (cont'd)

Connectors	• **Hydraulic connector:** hydraulically actuated equipment that locks and seals on end connections and provide mechanical and/or hydraulic path • **LMRP Connector**: connects the LMRP to the BOP stack • **Well Head Connector**: connects the BOP stack to the well head • **C&K Stabs**: connecting C&K Lines between LMRP and BOP stack • **Conduit and Hotline Hydraulic Stabs**: connectors coupling surface hydraulic fluid to the LMRP and/or Control Pods (pod connector) • **Wetmate Connector**: offer wet make-up of electrical interfaces in subsea power systems • High Pressure High Temperature **(HPHT) Sensors**: HPHT Sensors to detect and transmit pressure and temperature of well bore fluids at the well head. • Electronic Riser Angle **(ERA) Sensors**: ERA Sensors to detect and communicate riser angle offset.
Stack-mounted Accumulators (Autoshear)	Stack-mounted accumulator dedicated to provide hydraulic energy (volume and pressure) for emergency operation of casing shear rams and blind shear rams. **Accumulator:** a pressure vessel to store hydraulic energy charged with inert gas and used to store hydraulic fluid under pressure.

APPENDIX B – MAINTENANCE AND OPERATING MANUAL AND MAINTENANCE PLAN
MIT ACTIVITIES

B-1: Overall BOP MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	All Rams		Operate all rams	Scheduled Test	x													
Overall BOP system			Look for hydraulic leaks	Scheduled Inspection	x			x										
Overall BOP system	General		Function test all rams, annulars, subsea actuated gate valves, diverter, other items run subsea, choke manifold, kill and choke lines, standpipe manifold, top drive safety valves, safety valves, and IBOP	Scheduled Test		x			x				x					
Overall BOP system	General		During each function test, record and analyze (a) volumes to open and close each function, and (b) time to open and close each function to ensure that full working operation is maintained. Compare with previous results to ensure within API RP 53 3rd Edition Specifications	Scheduled Test		x			x				x					
Overall BOP system	General		Ensure that there are no leaks on the equipment	Scheduled Inspection		x			x									
Overall BOP system	General		Pressure test all BOP and related equipment as required by API RP53 / Pressure test all BOPs, annulars, wellbore components and their connections and BOP control/operating system	Scheduled Test			x (not to exceed 21 days)		x			x	x			2 years & 5 years	Prior to running assembled stack and/or when any component change/repair is made.	

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	General		Pressure test all BOPs, annulars, wellbore components and their connections, BOP operating unit, choke manifold, kill and choke lines, standpipe manifold, top drive safety valves, safety valves and IBOPs	Scheduled Test													-When BOP is running and latched to the wellhead. - Prior to drilling into a suspected high pressure zone - Prior to initial opening of drill stem test tools.	
Overall BOP system	General		Function test all components with both control pods from the driller's and remote control panels.	Scheduled Test									x					
Overall BOP system	General		Function test all valves from both pods. Check all hydraulic connections in the circuit for operating fluid leaks.	Scheduled Test									x					
Overall BOP system	General		Final Surface Testing and Verifications prior to launching stack: - Perform function test on both pods and all SEMs. - Make sure that the pressure, temperature sensors, ERA sensors are operating correctly. - Perform pressure test of the pod to the maximum regulator output, not to exceed rated pressure, and visually examine for leaks. - Make sure that pre-charge pressure in all accumulators	Scheduled Test									x					

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			has not bled down since step one was performed. - Make sure that all inclinometers are operating correctly. - Make sure that all gyros are operating correctly.															
Overall BOP system	Accumulators - LMRP		Prior to well control pressure testing, perform the Accumulator Drawdown Test as required by API RP53, section 18.7.1 for subsea BOP	Scheduled Test									x					
Overall BOP system	Annular		Upper annular - Perform wellbore pressure test.	Scheduled Test	x			x							x			x
Overall BOP system	Annular		Lower Annular - Perform wellbore test.	Scheduled Test				x						x				
Overall BOP system	all rams		Function test ram locking devices	Scheduled Test									x					
Overall BOP system	all rams		Perform a low pressure signature test on each operator. Compare the minimum required closing and opening pressures, to the previous test pressures.	Scheduled Test											x			
Overall BOP system	all rams		Pressure test the ram operator hydraulic chambers to maximum operating pressure.	Scheduled Test											x			
Overall BOP system	all rams		Pressure test all rams to low pressure and maximum working pressure with the locks engaged and the closing pressure vented.	Scheduled Test											x			
Overall BOP system	all rams		Perform a field wellbore pressure test, an internal hydraulic pressure test, and a locking hydraulic pressure test.	Scheduled Test											x	3 years		

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	Pipe & Test Rams		Rams - Hydraulic leak test (Operate all rams and check for external leaks)	Scheduled Test	x													Keep adequately greased
Overall BOP system	Pipe & Test Rams		Ram BOPs - Perform field wellbore pressure test. Check for leaks	Scheduled Test				x						x				
Overall BOP system	Pipe & Test Rams		Perform a field wellbore test, an internal hydraulic pressure test, and a locking hydraulic pressure test.	Scheduled Test							x							
Overall BOP system	Shear Rams		Pressure test blind/shear rams	Scheduled Test													Prior to drilling out after each casing string has been set. NOT TO EXCEED 42 days	
Overall BOP system	Choke & Kill		Function test all stack mounted choke and kill valves.	Scheduled Test		x												
Overall BOP system	Choke & Kill		While running BOP's and riser, choke/kill lines are to be tested to the working pressure of the ram BOP's. (API RP53 18.3.2.2)	Scheduled Test									x					
Overall BOP system	Choke & Kill		After landing the BOP stack, test choke/kill lines to the working pressure of the ram BOP's. (API RP53 18.3.2.2)	Scheduled Test					x									
Overall BOP system	Connectors		Pressure test the ring gasket retaining circuit, if applicable. Chart record the tests.	Scheduled Test								x						
Overall BOP system	Connectors		Perform low pressure unlock test, as per the manufacturers specifications.	Scheduled Test								x						

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	Connectors		On the test stump, measure and record unlatch to latch indicator rod travel.	Scheduled Test								x						
Overall BOP system	Connectors		Once the LMRP is installed, function test connectors, i.e., extend and retract, to confirm proper operation and alignment.	Scheduled Test									x			2 years		
Overall BOP system	Connectors		Pressure test the hydraulic operating chambers (primary lock, secondary lock, primary un-lock and secondary un-lock) to max operating pressure. All tests are to be chart recorded. (API RP 53 18.3.2.4)	Scheduled Test									x			2 years		
Overall BOP system		Hydraulic Hoses & Connections	Pressure test all BOP component operating lines to full rated working pressure. Reference API RP53, section 12.5.1 and 17.3.8 item 8.	Scheduled Test								x						
Overall BOP system	Emergency & Secondary Controls	Autoshear System	Test the Autoshear System on Surface (if equipped)	Scheduled Test									x					
Overall BOP system	Emergency & Secondary Controls	Deadman System	Test the Deadman System on Surface	Scheduled Test									x					
Overall BOP system	Emergency & Secondary Controls	EDS	Test the Emergency Disconnect System (EDS) on Surface	Scheduled Test									x					

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	Emergency & Secondary Controls	Emergency Function	Test all functions and sequences of the EDS, autoshear and deadman	Scheduled Test									x			5 years	- At commissioning - When any changes are made - During BOP control system recertification	
Overall BOP system	Emergency & Secondary Controls	½ -gallon Accumulator	Check precharge	Scheduled Inspection									x					
Overall BOP system	Emergency & secondary controls		Function test the operation of the back-up control systems	Scheduled Test									x					
Overall BOP system	Emergency & Secondary Controls	Acoustic	Test all acoustic functions	Scheduled Test									x				- At commissioning - When any changes are made - During BOP control system recertification - 1 acoustic function every 21 days	
Overall BOP system	Emergency & Secondary Controls	ROV	Test one function of the ROV intervention panel for the BOP every time the BOP is function tested, while Subsea. Create a schedule for testing each function, ONLY ONE function is tested each time.	Scheduled Test		x												

Table B-1: Overall BOP MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Overall BOP system	Emergency & Secondary Controls	ROV	Test all ROV functions	Scheduled Test									x					
Overall BOP system	Emergency & Secondary Controls	ROV	Function test all critical ROV functions, as defined by API	Scheduled Test							1 critical function every 90 days						- At commissioning - When any changes are made - During BOP control system recertification	
Overall BOP system			Perform wellbore test	Scheduled Test									x					
Overall BOP system			Perform hydraulic test	Scheduled Test									x					

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Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	HPU	Filter/Strainer	Y-Type Strainer - Clean element	Planned Maintenance		x												
Surface Control System	HPU	Filter/Strainer	Hydraulic Suction Filter - Clean Filter	Planned Maintenance			x											
Surface Control System	HPU	Filter/Strainer	High Pressure Filter - Clean Filter	Planned Maintenance			x											
Surface Control System	HPU	Filter/Strainer	Check HP filter isolation valves for leaks	Scheduled Inspection			x											
Surface Control System	HPU	Mixing Unit	Water Regulator - Oil adjustment screw	Scheduled Inspection		x												
Surface Control System	HPU	Mixing Unit	Verify mixing system flowmeter and totalizer functions and check manual valves for leaks	Scheduled Inspection			x											
Surface Control System	HPU	Mixing Unit	Check on-off function of mixing system inlet water valve	Scheduled Test			x											
Surface Control System	HPU	Mixing Unit	Verify function and full stroking of inlet water valve and clean inlet water strainer	Scheduled Test						x								
Surface Control System	HPU	Mixing Unit	Check mixing system outlet filter elements and replace as necessary	Planned Maintenance			x											
Surface Control System	HPU	Pump	Pump - Check pump packing glands and belt drive,	Scheduled Inspection		x												
Surface Control System	HPU	Pump	Check suction valve stem for leaks	Scheduled Inspection			x											
Surface Control System	HPU	Pump	Pump - Check crankcase oil	Scheduled Inspection			x											

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	HPU	Pump	Pump Motor - Check bearing lubrication	Scheduled Inspection			x											
Surface Control System	HPU	Pump	Change crankcase oil	Planned Maintenance														First 30 hours of operation and then every 300 hours
Surface Control System	HPU	Pump	Check coupling for wear	Scheduled Inspection						x								
Surface Control System	HPU	Pump – Engine-driven High Pressure Pumps	Check engine oil level, plunger coolant seals for leakage, plunger packing for leakage, suction and discharge valves are fully open, rod and main bearing oil seals for leakage, and drive train and clutch	Scheduled Inspection	x													
Surface Control System	HPU	Pump – Engine-driven High Pressure Pumps	Degrease and clean system, clean pump and engine air breathers, and check system studs, nuts, and screws for tightness	Planned Maintenance and Scheduled Inspection				x										
Surface Control System	HPU	Pump – Engine-driven High Pressure Pumps	Check pump and engine oil and coolant levels, inspect battery and cables, check engine fuel level, check PTO and drive train for looseness, check pump drives, ensure supply water filters and strainers are clean, and check supply water is flowing into the system	Scheduled Inspections														Prior to starting engine-driven pump system
Surface Control System	HPU	Reservoir, Mixing Unit	Test low fluid level alarms	Scheduled Test		x												

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	HPU	Reservoir, Mixing Unit	Visually inspect reservoir float	Scheduled Inspection						x								
Surface Control System	HPU	Reservoir, Mixing Unit	Clean reservoir breather caps	Planned Maintenance						x								
Surface Control System	HPU	Reservoir, Mixing Unit	Check reservoir piping and valves for leaks	Scheduled Inspection						x								
Surface Control System	HPU	Reservoir, Mixing Unit	Sample mixed fluids for cleanliness	Predictive Maintenance						x								
Surface Control System	HPU	Hydraulic Hoses & Connections	Ensure all control system interconnecting piping and hoses are protected from damage during drilling operations.	Scheduled Inspection								x						
Surface Control System	HPU	Hydraulic Hoses & Connections	Visually inspect the condition and security of all BOP pipe work and hoses between the hydraulic control unit and the BOP stack. Check fittings and fastenings for deterioration.	Scheduled Inspection								x						
Surface Control System	HPU	Regulators	Regulators - Rebuild all regulators or replace with rebuilt spares	Planned Maintenance											x	2 years		
Surface Control System	Power	Uninterrupted Power Source (UPS)	Visually inspect overall condition of batteries and battery charger.	Scheduled Inspection				x			x	x			x			
Surface Control System	Power	Uninterrupted Power Source (UPS)	Verify batteries are charging.	Scheduled Inspection							x							
Surface Control System	Power	Uninterrupted Power Source (UPS)	Verify unit is clean including ventilation.	Scheduled Inspection							x							
Surface Control	Power	Uninterrupted Power Source	Inspect cooling fans. (If applicable)	Scheduled Inspection							x							

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
System		(UPS)																
Surface Control System	Power	Uninterrupted Power Source (UPS)	Check light emitting diode (LED) status that UPS is not in Bypass mode (if applicable)	Scheduled Inspection							x							
Surface Control System	Power	Uninterrupted Power Source (UPS)	Verify that all controls and indicator lights operate correctly.	Scheduled Inspection							x				x			
Surface Control System	Power	Uninterrupted Power Source (UPS)	Check and record float voltage of batteries, in Rig's Register.	Scheduled Inspection							x				x			
Surface Control System	Power	Uninterrupted Power Source (UPS)	Clean out cabinet with a vacuum cleaner, ensure no moisture present.	Planned Maintenance											x			
Surface Control System	Power	Uninterrupted Power Source (UPS)	Verify the security and integrity of all cables, glands, enclosures and connections.	Scheduled Inspection											x			
Surface Control System	Power	Uninterrupted Power Source (UPS)	Simulate power failure and ensure that the battery backup system has sufficient duration or is able to perform desired function to the required standard, repair / replace as required.	Scheduled Test											x			
Surface Control System	Power, MUX Control System	Electrical Junction Boxes	Test functioning of electrical enclosure alarm	Scheduled Test			x											
Surface Control System	Power, MUX Control System	Electrical Junction Boxes	Inspect for corrosion & dampness	Scheduled Inspection						x								
Surface Control System	Power, MUX Control System	Electrical Junction Boxes	Inspect electrical enclosure interconnect cable for damager	Scheduled Inspection						x								
Surface Control System	Power, MUX Control System	Electrical Junction Boxes	Check electrical enclosure buttons and lenses for cracks or damage	Scheduled Inspection						x								
Surface Control System	MUX Control System	MUX Cable	Disconnect MUX cable at reel junction box and measure and record insulation resistance for	Scheduled Inspection												5 years		

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			all MUX cores.															
Surface Control System	MUX Control System	MUX Cables	Insulation check on copper conductors throughout its entire length, Including slip ring and connector.	Scheduled Inspection									x					
Surface Control System	MUX Control System	MUX Cables	Fiber optic conductors will need to be checked with Optical Time Domain Refractometer	Scheduled Inspection									x					
Surface Control System	MUX Control System	MUX Cables	Check outer sheath of the cable for any damage when spooling cables onto reel. Repair as required.	Scheduled Inspection												5 years		
Surface Control System	MUX Control System	MUX Connectors	Visual inspection of connector terminals while connector is removed for megging. (check for corrosion from water ingression and other contaminates)	Scheduled Inspection									x					
Surface Control System	MUX Control System	MUX Connectors	Visual inspection signs of cable twisting in connector.	Scheduled Inspection									x					
Surface Control System	MUX Control System	MUX Connectors	Inspect breakaway bolts if applicable	Scheduled Inspection									x					
Surface Control System	MUX Control System	MUX Connectors	Clean all connectors and refit.	Planned Maintenance												5 years		
Surface Control System	MUX Control System	Central Control Console	Test lamps	Scheduled Test	x													
Surface Control System	MUX Control System	Central Control Console	Verify module LED indicate normal operation	Scheduled Inspection		x												
Surface Control System	MUX Control System	Central Control Console	Confirm operation of cooling fan and clean filter	Planned Maintenance				x										
Surface Control	MUX Control System	Central Control	Inspect exterior of each bay for damage and corrosion and	Scheduled Inspection				x										

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
System		Console	inspect for ingress of dust and moisture															
Surface Control System	MUX Control System	Central Control Console	Clean and inspect interior of each panel	Scheduled Inspections											x			
Surface Control System	MUX Control System	Central Control Console	Measure power supply output voltage	Scheduled Inspection											x			
Surface Control System	MUX Control System	Central Control Console	Exercise manual controls that are not used in routine operations	Scheduled Test											x			
Surface Control System	MUX Control System	Central Control Console	Replace PLC CPU, PCM module and hand-held monitor batteries	Planned Maintenance											x			
Surface Control System	MUX Control System	Slip Ring	Inspect electrical slip ring and check inside for corrosion and moisture. Check gland ring and cables for damage and ensure all cable connections are tight. Grease slip ring bearings as required.	Scheduled Inspection												5 years		
Surface Control System	MUX Control System	Reels	Ensure there is adequate protection on the multi-pin and cable connections.	Scheduled Inspection												5 years		
Surface Control System	MUX Control System	Reels	If applicable, check silica gel bags. Blue color is OK. Pink color requires replacement.	Scheduled Inspection												5 years		
Surface Control System	MUX Control System	Reels	Inspect electrical contacts inside junction boxes for corrosion.	Scheduled Inspection												5 years		
Surface Control System	Rigid conduit & hotline	Reels	Function test all functions on the hose reel control panels	Scheduled Test									x					
Surface Control System	Rigid Conduit & Hotline	Reels	Check and lubricate all moving parts as required.	Planned Maintenance												5 years		

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	Rigid Conduit & Hotline	Reels	If applicable, replace all corrosion inhibitor pads.	Planned Maintenance												5 years		
Surface Control System	Rigid Conduit & Hotline	Reels	Inspect inner unit for corrosion, damage, moisture etc. Clean carefully with dry cloth or vacuum cleaner.	Planned Maintenance												5 years		
Surface Control System	Rigid Conduit & Hotline	Reels	Ensure that openings and glands are properly sealed with correct, certified blanking plugs.	Scheduled Inspection												5 years		
Surface Control System	Rigid Conduit & Hotline	Reels	If applicable, check anti-condensation heaters for correct operation.	Scheduled Inspection												5 years		
Surface Control System	Rigid Conduit & Hotline	Reels	Grease main hydraulic supplies fluid swivel	Planned Maintenance														Rig Move
Surface Control System	Rigid Conduit & Hotline	Reels	Check conditions of the RBQ plate, receptacle seals and plate securing bolts clean and lubricate as required.	Scheduled Inspection														Rig Move
Surface Control System	Rigid Conduit & Hotline	Reels	Check quick disconnect nipple assembly connections move freely in RBQ plate holes. Any quick disconnect nipple assembly connections found to be seized must be removed and cleaned to allow movement in RBQ plates.	Scheduled Inspection														Rig Move
Surface Control System	Rigid Conduit & Hotline	Reels	Check condition and functionality of vent plate.	Scheduled Inspection														Rig Move
Surface Control System	Rigid Conduit & Hotline	Reels	Check function of all panel valves, regulator and gauges. Lubricate as required. Repair or replace as required	Scheduled Inspection														Rig Move
Surface Control System	Rigid Conduit & Hotline	Reels	Check security of shields on valves for critical functions	Scheduled Inspection														Rig Move

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Check oil and fill line lubricator	Scheduled Inspection	x													
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Change oil in motor and gearbox.	Planned Maintenance														Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Check Motor and drive system functionality.	Scheduled Test														Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Check and service brake system	Scheduled Test														Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Check level wind spooler system (if fitted).	Scheduled Test														Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Lubricate drum and level wind spooler drive chains and sprockets (if fitted)	Planned Maintenance														Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Reels	Grease drum bearings.	Planned Maintenance											x			Rig Move
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Check oil level and fill air motor case to proper level prior to each operation	Planned Maintenance	x													
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Check air line lubricator	Scheduled Inspection		x												
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Service air motor and inspect breather cap	Scheduled Inspection														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Remove motor case condensate drain plug	Planned Maintenance														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Inspect and clean air motor drive sprocket and chain	Planned Maintenance														X

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Inspect for damage and grease air motor sprocket and chain	Planned Maintenance														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Constant Tension System	Check disc brake system for proper operation and inspect brake linings for wear	Scheduled Inspection														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Level Wind Assembly	Inspect and clean level wind sprockets and chain	Planned Maintenance														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Level Wind Assembly	Grease sprocket and chain	Planned Maintenance														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Level Wind Assembly	Inspect chain and sprocket for signs of wear	Scheduled Inspection														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Level Wind Assembly	Adjust level wind clutch	Planned Maintenance														X
Surface Control System	Rigid Conduit & Hotline, MUX Control	Level Wind Assembly	Clean level wind diamond screw and pawl	Planned Maintenance														X
Surface Control System	Accumulator	Accumulator	Accumulator Bottles - Check precharge	Scheduled Inspection		x												
Surface Control System	Accumulators - surface	Accumulators	Conduct accumulator performance test by charging the system, switching off the charging pumps, install drill string into the BOP and LMRP, close one annular and all rams and open all function all ram locks, open one annular, unlock and open all rams and close all subsea actuated gate valves, monitor accumulator pressure closely, switch on all accumulator pumps and record the recharging time	Scheduled Test									x					

Table B-2: Surface Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Surface Control System	Control Panels	Control Panels	Verify functioning of manual shear seal valves, solenoid air valves, and pressure switch feedback; and check panel plumbing and manual valves for leaks	Scheduled Inspection			x											
Surface Control System	Control Panels	Control Panels	Check control panel assembly air cylinder for leaks and full stroke	Scheduled Inspection						x								
Surface Control System	Control panel	HPU Control panel	Check all tubing fittings inside console for leaks	Scheduled Inspection									x				x	

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems		Make sure that all pod fasteners (i.e., cap-screws, bolts, nuts, etc.) are secure. Re-torque fasteners if required.	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	PODs	Clean and inspect POD when recovered from subsea	Scheduled Inspection											At least once a year			
Subsea Control System	Blue & Yellow Subsea Control Systems	Check Valves	Tubing - Replace all tubing check valves	Planned Maintenance											x	2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Check Valves	Replace all the check valves in the wedge extend/retract circuit.	Planned Maintenance												2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Compensated Chamber (Solenoid)	Examine dielectric fluid level in the electronic-hydraulic (EH) housing.	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Compensated Chamber (Solenoid)	If the EH section is removed, replace O-rings on the seal sub J plates	Planned Maintenance									x					
Subsea Control System	Blue and Yellow control	Compensated Chamber (Solenoid)	Check pressure-compensating assemblies if applicable.	Scheduled Inspection									x					
Subsea Control System	Blue and Yellow control	Compensated chamber, SEM	Visually inspect o-rings and pins at all SEM connections, one on the face and one on the inside diameter. Use an inspection mirror to look at connectors not in plain view. Replace o-rings if any flat	Scheduled Inspection												5 years		

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			spots or damage is evident. Lubricate o-rings with silicon grease.															
Subsea Control System	Blue & Yellow Subsea Control Systems	Flex hoses	Pod Piping - Inspect for leaks, tighten fittings. Repair and replace, as required.	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Flex hoses	Inspect, clean, and lubricate hoses. Plug ends of choke & kill lines	Planned Maintenance										x				
Subsea Control System	Blue & Yellow Subsea Control Systems	HPHT	Make sure that the pressure and temperature sensors are operating correctly. .	Scheduled Inspection											x	2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	HPHT	Calibrate all the BOP transducers	Scheduled Test												2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Manifolds	Manifold Blocks – Re-torque bolts	Planned Maintenance									x					x
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Prepare MUX control for time out of water; rinse with fresh water, visually inspect for damage, and keep stab and receptacle surfaces dry and greased.	Planned Maintenance									x					

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Cables: Examine the Pressure Balanced Oil Filled (PBOF) cables for; - damage - loss of DC 200 - water ingression. Perform insulation resistance test on all PBOF cables using a meter and record readings. Perform continuity test on all PBOF cables. If PBOF cable is removed, perform pressure test.	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Interconnecting Cables - Visually Inspect	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Interconnect Cables (Maintain 15-20% on a rotating basis) - Inspect and test	Scheduled Test									x			2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Interconnecting Cables - Test	Scheduled Test											x			
Subsea Control System	Blue & Yellow Subsea Control Systems	MUX subsea	Interconnecting Cables - Replace	Planned Maintenance												2years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Pilot and supply filters	Filters - Replace filter cartridges.	Planned Maintenance									x					

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	Pilot and supply filters	Replace all filters after all BOP pressure and function tests	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Pilot and supply filters	Filters - Replace filter cartridge/bowl seal	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	POCV	Shear Seal Valves - Rebuild or replace 20% of the shear seals annually	Planned Maintenance											x	5years		
Subsea Control System	Blue & Yellow Subsea Control Systems	POD Compensation Chamber	Check for water entering the chamber and pressure test	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	POD 5-gallon Compensator Assembly	Inspect and replace bladder	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	POD Magnetic Flow Meter	Inspect electrical connection and check coil pick-up signal	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	POD Magnetic Flow Meter	Replace flow meter	Planned Maintenance												2 years		

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	Pod Receptacle	Examine wedge for damage and adjustment while BOP and LMRP are split, including : sealing surfaces, actuator assembly of LMRP disconnect switch, extend/retract cylinder piston, we make/break connector, mounting bolts and electrical connectors	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Pod Receptacles	Female Receptacles on Stack - Keep both tapered surfaces dry and greased when out of water. Check condition of packer seals.	Planned Maintenance									x	x				
Subsea Control System	Blue & Yellow Subsea Control Systems	Pod Receptacles	Packer Seals - Inspect for damage. Replace seals	Scheduled Inspection									x		x			
Subsea Control System	Blue & Yellow Subsea Control Systems	Pod Receptacles	Replace all packer seals with new seals.	Planned Maintenance												2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	POD Pressure Transmitter	Inspect connection and check calibration	Scheduled Inspection									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	POD Pressure Transmitter	Replace transmitter	Planned Maintenance												5 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	POD FCR Umbilical	Inspect	Scheduled Inspection									x					

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	Regulator	Remote Hydraulic Regulator (HKR) Valves - Operate through pressure ranges every 30 days. Replace O-rings.	Scheduled Test									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Regulator	HKR Valves – Install repair kit	Planned Maintenance											x			
Subsea Control System	Blue & Yellow Subsea Control Systems	Regulator	Manual hydraulic regulator (MKR) Valves - Operate through pressure ranges. Replace O-rings if necessary.	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Regulator	MKR Regulator Valves - Install repair kit	Planned Maintenance											x			
Subsea Control System	HPU, Blue & Yellow Subsea Control Systems	Regulators	Regulators - Rebuild all regulators or replace with rebuilt spares	Planned Maintenance											x	2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	SEM	Make sure that the 60 V pod power supply capacitors are correct. Replace the 60 V pod power supply.	Scheduled Inspection								x	x					
Subsea Control System	Blue & Yellow Subsea Control Systems	SEM	Check for water ingression into connector	Scheduled Inspection									x					

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	SEM	SEMs - Examine the internal connections in Sub Sea Electronic Modules (SEMs)	Scheduled Inspection											x	2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Shuttle Valve	Shuttle Valves - Check fittings for tightness	Scheduled Test										x				
Subsea Control System	Blue & Yellow Subsea Control Systems	Shuttle Valves	Shuttle Valves - Rebuild or replace 20% of the pod shuttle valves annually	Planned Maintenance											x	5 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Shuttle Valves	Replace o-rings	Planned Maintenance											x			
Subsea Control System	Blue & Yellow Subsea Control Systems	Shuttle Valves	Rebuild all the shuttle valves in the wedge extend/retract circuit or replace with new or reconditioned spares.	Planned Maintenance												2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Solenoid	CCSV Solenoid - Capacitance/insulation resistance test	Scheduled Test											x			
Subsea Control System	Blue & Yellow Subsea Control Systems	Solenoid	CCSV Solenoid - Replace	Planned Maintenance												5 years		

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	Solenoid	CCSV Fluid End - Install seal kit	Planned Maintenance													x	
Subsea Control System	Blue & Yellow Subsea Control Systems	solenoid valve	DDV (Maintain 15-20% on a rotating basis) - Perform capacitance/insulation resistance test on solenoid	Scheduled Test									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Solenoid Valves	Perform continuity check on the solenoid. Replace if required	Scheduled Test											x	2 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	SPM Valves	Inspect all SPM Valve springs for cracks and breaks.	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	SPM Valves	Replace all cracked and broken springs.	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	SPM Valves	SPM Valves (Maintain 15-20% on a rotating basis between wells) - Install seal kit as needed; install repair kit (every 12th seal kit) as needed	Planned Maintenance									x					x (install seal kit or repair kit, as needed)
Subsea Control System	Blue & Yellow Subsea Control Systems	SPM Valves	SPM Valves - Rebuild or replace 20% of the SPM Valves (to be rebuilt with new springs) annually	Planned Maintenance											x	5 years		

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	Blue & Yellow Subsea Control Systems	SPM Valves	SPM Valves - Install repair kit	Planned Maintenance												5 years		
Subsea Control System	Blue & Yellow Subsea Control Systems	Tubing	Pod Piping - Inspect fittings and joints. Replace if necessary	Scheduled Inspection									x		x			
Subsea Control System	Blue & Yellow Subsea Control Systems		Replace all O-rings that have been removed and test after assembly if applicable.	Planned Maintenance									x					
Subsea Control System	Blue & Yellow Subsea Control Systems	Seal Assembly	Replace	Planned Maintenance									x			5 years		
Subsea Control System			BOP Overall - Inspect bolts, nuts, studs for fatigue. Clean all exterior surfaces.	Scheduled Inspection										x				
Subsea Control System	Accumulators - LMRP	Accumulators	Check precharge.	Scheduled Test									x	x				
Subsea Control System	Accumulators - LMRP	Accumulators	Install new bladder kit	Planned Maintenance												5 years		
Subsea Control System	All hydraulic surface & subsea	Hydraulic Hoses & Connections	Visually inspect the condition and security of all BOP pipe work and hoses between the hydraulic control unit and the BOP stack. Check fittings and fastenings for deterioration.	Scheduled Inspection								x		x				

Table B-3: Subsea Control MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Subsea Control System	All hydraulic surface & subsea	Hydraulic Hoses & Connections	Ensure all control system interconnecting piping and hoses are protected from damage during drilling operations.	Scheduled Inspection								x						
Subsea Control System	Emergency & Secondary Controls		Rebuild or replace all of the following control components that control the BOP critical functions (i.e., EDS, Deadman (AMF), Auto Shear, EHBS, and pod select)	Planned Maintenance											x	2 years		
Subsea Control System	Emergency & Secondary Controls	EDS	Make sure that the inclinometers are operating correctly.	Scheduled Inspection											x	2 years		
Subsea Control System	Emergency & Secondary Controls	ROV	Test all ports on the ROV intervention panel while on surface.	Scheduled Test									x					
Subsea Control System	Annular, rams, C&K Valves		Clean and Inspect BOP Components	Scheduled Inspection									x					

Table B-4: BOP Stack MIT Activities

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack			Make sure the correct number and type of anodes are being utilized on the LMRP and Stack per the rig drawings.	Scheduled Inspection									x					
BOP Stack			Check the condition of the sacrificial anodes.	Scheduled Inspection							x							
BOP Stack			Verify zero resistance between anodes and material to be protected. Eliminate resistance, if found.	Scheduled Test									x					
BOP Stack			LMRP Spider Assembly - Inspect, clean and lubricate	Scheduled Inspection										x				
BOP Stack			Clean and Inspect BOP Components	Scheduled Inspection									x					
BOP Stack			Repair or replace parts require to bring equipment to original specifications	Planned Maintenance												3 Years		
BOP Stack			Overall BOP Stack - Inspect bolts, nuts, and studs for fatigue. Clean all exterior surfaces.	Scheduled Inspection										x				x
BOP Stack			Flex Joint - Inspect & clean all metal parts, elastomer of flex element, wear rings and sleeves, nipple, mating surfaces, and back flange	Scheduled Inspection									x	x				
BOP Stack			Ring Gaskets - Inspect, replace as necessary	Planned Maintenance										x				
BOP Stack			Guide legs - Inspect and clean	Scheduled Inspection										x				
BOP Stack			Shackles - Clean/grease. Replace if needed	Planned Maintenance										x				
BOP Stack			Overall LMRP - Inspect bolts, nuts, studs for fatigue	Scheduled Inspection										x				
BOP Stack			Overall LMRP - Clean all exterior surfaces	Planned Maintenance										x				
BOP Stack	Annular		Upper Annular - Inspect elements for severe wear or damage.	Scheduled Inspection	x			x							X			X

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	Annular		Lower Annular - Inspect each element for severe wear or damage.	Scheduled Inspection				x						x				
BOP Stack	Annular		Perform between wells and yearly maintenance	Planned Maintenance												2.5 years		
BOP Stack	Annular		• Remove the annular BOP Head, Opening Chamber Head, piston and internal components. Remove and discard all seals. • Visually and dimensionally inspect the piston and the body sealing areas; the annular head; wear plate and replace as required; the annular head latching profile for mechanical damage or corrosion. • Remove and inspect the jaws and jaw operating screws, replace all seals and visually and dimensionally inspect the jaw recess and operating screw threads in the body. • Reassemble the annular with all new seals. On completion of the rebuild, pressure test the opening and closing chambers to maximum operating pressure	Planned Maintenance												2 years		
BOP Stack	Annular		• Remove the annular top, piston and internal components. Remove and discard all seals. • Visually and dimensionally inspect the piston and the body sealing areas and the annular top, paying particular attention the sealing areas. • Rebuild the annular with all new seals. On completion of the	Planned Maintenance												2.5 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling – Daily	Drilling – 7 Days	Drilling – 14 Days	Drilling – 30 Days	Upon Latching	Pre-Deployment and Between Wells – 60 Days	90 Days	180 Days	Between Wells	Each Trip	Major Overhaul – Annually	Major Overhaul – Multiyear	Miscellaneous – As Required	Miscellaneous – As Needed
			rebuild, pressure test the opening and closing chambers to maximum operating pressure or as per OEM recommendations • Pressure test the well bore to low pressure and to 70% of maximum working pressure as per the rig specific BOP test procedure															
BOP Stack	Annular		• Completely strip the annular to its component parts. Inspect the areas outlined below and compare the actual values found, to the OEM specifications. • Visually, dimensionally and NDT inspect the annular upper and lower hub or flange connections and weld; the annular body and dogs; the end connection ring grooves; all threaded bolt / stud holes; all threaded fasteners; the piston and wear ring; and the OCH (API RP53 18.10.3). Carry out hardness tests (API RP53 18.10.3) • Reassemble the annular with all new seals. On completion of the reassembly, pressure test the opening and closing chambers to maximum working pressure, prior to installing the element. Chart record the tests. (API RP53 18.13.4) • Pressure test the well bore to low pressure and to maximum working pressure. • Seal all ports and protect all sealing areas and paint the equipment to specification. Preserve for long term storage and protect for shipping. (API RP53	Planned Maintenance												5 years		

Table B-4: BOP Stack MIT Activities (cont’d)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			18.11.5)															
BOP Stack	Annular	Wedge Cover	Verify bolt torque on ring joint connections, inspect and clean ring joint sealing surface, inspect and clean all studs and nuts, inspect quick disconnect o-rings, clean inspect for damage and lubricate BOP,	Scheduled Inspection and Planned Maintenance									x					
BOP Stack	Annular	Wedge Cover	Remove and inspect upper housing and sealing element, Repair as needed. Perform hydraulic and well bore pressure test	Scheduled Inspection and Scheduled Test											X	3 years		
BOP Stack	Annular	Wedge Cover	Disassemble wedge cover, repair or replace all parts required to bring equipment back to OEM specification, replace all seals, and perform field wellbore pressure test, internal hydraulic pressure test, and locking hydraulic pressure test	Planned Maintenance and Scheduled Test												3 years.		
BOP Stack	All Rams	Ram Locks	Perform a back drive test and a minimum unlocking pressure test. Record information in work order notes.	Scheduled Test														Rig Move
BOP Stack	All Rams		Inspect locking system	Scheduled Inspection											x			

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	All Rams		• Remove ram packers and top seals, Perform dimensional checks on all ram blocks • NDT Ram shaft ends and ram blocks • Measure the vertical height of the ram cavity at the seal area of the upper seal seat using an inside micrometer. Measure the vertical height of the ram block using an outside micrometer. • N.D.T. 10% of the bonnet bolts. If problems are found NDT all bonnet bolts • Check that the weep hole in the intermediate flange is clear. If a check valve is fitted ensure that it is installed properly and is clear. • Remove the bonnet seal carriers and visually inspect for scoring, pitting or other damage. Replace all O rings and carrier spring. • Remove the MPL assembly and inspect. Replace both of the overhauling nut bearings and the clutch springs. Ensure all locking devices are properly reassembled and all of the required parts are installed.	Planned Maintenance											x			
BOP Stack	All Rams		If a pressure test fails, a lock out test should be carried out to verify the MPL clutch condition.	Scheduled Test											x			
BOP Stack	BOP Stack	BOP Stack	Completely disassemble	Planned Maintenance												3 years		
BOP Stack	BOP Stack	BOP Stack	Replace all seals, including secondary flow valve	Planned Maintenance												3 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	BOP Stack	BOP Stack	• Disassemble the entire BOP to its component parts. For tracking purposes, assign a RMS job identification number to all components (API RP53 18.10.3) • Inspect the areas outlined below and compare the actual values found, to the OEM specifications. Carry out any required repairs in accordance with the OEM specifications or OEM approved procedures. (API RP53 18.10.3) • Take body hardness readings and record in RMS, as per the OEM recommendations. (API RP53 18.10.3 and 18.3.7) • Visually and dimensionally inspect the bonnet sealing areas on the bodies. (API RP53 18.10.3) • Visually and dimensionally inspect the ram cavities. (API RP53 18.10.3) • Visually and dimensionally inspect the through bore. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the ram blocks. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the bonnet bolt threads and NPT hydraulic ports if equipped on the body. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the hinge assemblies if equipped. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the cylinder liner, operating piston and lock assembly. Check the sealing	Planned Maintenance												5 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			surfaces for wear or damage and for the hard facing separating from the parent material. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the bonnet, including the bonnet seal groove and seal bores. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect bonnet bolts/studs and nuts. (API RP53 18.10.3) • Re assemble the operators and Locks with all new seals, and install on the body. On completion of the re assembly, perform function of manual locks or signature test on hydraulic Locks then pressure test the opening and closing chambers to maximum working pressure. Chart record the tests (API RP53 18.13.4) • Pressure test the well bore to low pressure and to rated working pressure, with the locks engaged and the ram closing pressure (Lock pressure if applicable)vented. Chart record the tests. (API RP53 18.13.4) • Preserve for long term storage and protect for shipping. (API RP53 18.11.5)																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	All Rams		a. Fixed-Bore Pipe Rams or Blind/Shear Rams: 1) If no pressure is lost, the integrity of the ram packers and seals is verified under low pressure and the proper operation of the MPL locks is confirmed. Continue to the Step 10. 2) If pressure is lost, stop the test and vent the pressure from the BOP. Make necessary repairs. If repairs require disassembly of the BOP, perform the wellbore test again, beginning with Step 2.	Scheduled Test													x	
BOP Stack	All Rams		• Clean & inspect lower double end connection and gasket prep. • Clean & inspect ram exterior for corrosion & coating condition. • Clean, inspect, grease & protect exposed side outlets & gasket preps.	Planned Maintenance														Rig Move
BOP Stack	All Rams		Chart Low pressure signature test on MPL's and maximum working pressure test on operators. If test fails make repairs as required and repeat tests.	Scheduled Test														Rig Move

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	All Rams		• Open Bonnets and clean the bonnet bolts. • Check the bonnet bolt threads for damage or thread loss through corrosion, using a thread profile gauge. Check the bolt shoulder bearing faces for signs of galling, burr's or raised edges that would cause excessive friction. • Visually check the bolt shanks for signs of diameter reduction (necking), which would indicate the bolt had been stressed beyond the material elastic limit. If in doubt, measure the outside diameter (OD) of the shank at various points along its length to ensure a consistent OD. • Lubricate the bolt threads and shoulders on completion. • Check the bolt shoulder bearing surfaces on the bonnets for galling, burr's or raised edges that would cause excessive friction. • Check the bonnet bolt threads in the BOP body for damage or thread loss through corrosion, using a thread profile gauge. • With the bonnets open and the rams in the closed position, inspect the exposed ram shaft for damage such as scoring, pitting or gouging, if light damage is found it can be smoothed off using fine emery paper. • Check that the ram shaft seal retainer is in place and secure.	Planned Maintenance														Rig Move

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval															
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous			
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			• Remove the bonnet seals and clean and inspect the seal grooves for pitting or indentations that could cause well bore leakage. Minor defects can be smoothed out with emery cloth. • Clean the bop body to bonnet sealing face and check for pitting or indentations that could cause well bore leakage. Minor defects can be smoothed out with emery cloth. • Check the ram packer condition and replace as required. Replace top seal if there are signs of cuts, wear or scoring that could cause well bore leakage. Refer to the next well program to determine if the ram packer condition warrants change out. . • Inspect the ram blocks for damage to the pipe guides or pipe bore due to closure on a tool joint or other oversized component of the drill string. Any raised burrs around the pipe bore that could score the ram cavity, can be removed with a file or 60 grit sanding disk. If the pipe guides show signs of damage, they should be MPI inspected to ensure there are no cracks. • Inspect the ram bodies for scoring, pitting or indentations. Any minor defects should be smoothed out.																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			• Clean and inspect the ram cavities for scoring, pitting or any other damage. Pay particular attention to the top wear plate where the top seal makes sealing contact. Any scoring or pitting can be hand dressed using a smooth file or fine emery cloth. Remove only the sharp raised edges adjacent to the scores. • Ensure top seal/wear plate and bottom wear plates are in place and secure. • Inspect the intersection between the ram cavities and the well bore for damage caused by the drill bit. Any sharp raised edges should be filed smooth. • Check the through bore for key seating damage. • On completion of all checks and inspections, fit new bonnet door seals and lubricate the BOP body face and the bonnet face with light oil. • Lightly grease the ram blocks and ram cavities. • Close the bonnets and torque the bonnet bolts to the correct value. The coefficient of friction of the thread lubricant in use must be considered when selecting the torque value.																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			• Perform low and rated working pressure well bore tests following the rig specific bop surface test procedures. (API RP53 18.13.4) These surface tests will be performed with the locking system engaged and the closing pressure vented. Chart record all well bore tests • On completion of testing visually check that all ram blocks are fully retracted. • Inspect weep holes on all bonnets to ensure they are clean and free from any blockage.															
BOP Stack	Pipe & Test Rams			Planned Maintenance							x							
BOP Stack	Pipe & Test Rams		Open doors and inspect visually	Scheduled Inspection							x				x			
BOP Stack	Pipe & Test Rams		Remove and inspect ram assemblies	Scheduled Inspection									x					
BOP Stack	Pipe & Test Rams		Grease door hinges	Planned Maintenance									x					
BOP Stack	Pipe & Test Rams		Measure rams and ram cavity.	Scheduled Inspection											x			
BOP Stack	Pipe & Test Rams		Rams (non-intrusive (doors closed)) - Perform field wellbore pressure test to detect leaks	Scheduled Test				x					x					After cementing jobs
BOP Stack	Pipe & Test Rams		Rams (intrusive (doors open)) - Visually inspect	Scheduled Inspection							x							
BOP Stack	Pipe & Test Rams		Rams (intrusive (doors open)) - Perform (1) field wellbore pressure test, (2) internal hydraulic pressure test, and (3) locking hydraulic pressure test	Scheduled Test							x				x	3 years		
BOP Stack	Pipe & Test Rams		Rams (intrusive (doors open)) - Measure rams and ram cavities	Scheduled Inspection											x			
BOP Stack	Pipe & Test Rams		Rams (intrusive (doors open)) - Completely disassemble. Repair or replace all parts required to bring	Planned Maintenance												3 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			to original specifications. Replace all seals, including secondary flow valve, and door bolts.															
BOP Stack	Pipe & Test Rams		Ram BOPs - Open ram doors and inspect assembly for wear. Replace components as necessary. Lubricate bolts and sealing surfaces. Grease hinges.	Planned Maintenance							x							
BOP Stack	Pipe & Test Rams		• Open one bonnet and inspect. Check the sealing surface on the ram piston rod for wear, pitting, and damage. • If the ram piston rod shows wear, pitting, or other damage replace it as follows; 1. Disassemble the ram BOP, 2. Inspect the bonnet to piston rod seal, wear ring, connecting rod seal, and wiper O-ring for wear, damage, and set. Replace if necessary. 3. Replace the ram piston rod with a new one. 4. Assemble the BOP, leaving the bonnets open. Replace seals as required. • Remove the bonnet seal from the bonnet seal carrier ring installed in the face of the bonnet. Inspect the seal groove for wear, pitting, or other damage. Remove minor pits and cores in the bonnet seal area groove with emery cloth. Coat the repaired surfaces with grease. Replace the bonnet seal ring carrier assembly if the bonnet seal groove is severely worn or damaged. Inspect the bonnet seal for wear, damage, and set. Replace if necessary. Lubricate bonnet seal with castor oil and	Scheduled Inspection									x				x	

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			install it into the carrier ring. • Inspect the sealing surface where the bonnet seal contacts the BOP body for wear, pitting, and other damage. Remove minor pits and scores in the bonnet seal area groove with emery cloth. Coat the repaired surfaces with grease. • Clean the ram compartment thoroughly and inspect for wear, pitting, and damage. Remove minor pits and scores in the field with emery cloth. • Measure the maximum vertical clearance between the rams and the upper seal seat in the ram compartment. • Install the ram assembly onto the piston rod and remove the lifting eye. Lubricate the ram assembly and the ram bore with castor oil. Retract the ram assembly into the bonnet. • Lubricate the threads and shoulders of the bonnet bolt threads. • Close the bonnet and torque the bonnet bolts																
BOP Stack	Pipe & Test Rams		Perform the MPL overhauling nut break-in procedure.	Planned Maintenance											x			
BOP Stack	Pipe & Test Rams		If the BOP is equipped with fixed-bore pipe rams or variable pipe rams, inspect the front packer and top seal for wear, cracking, and excessive hardness by comparison with a new packer/top seal. Replace if necessary.	Planned Maintenance									x				x	

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	Shear Ram		Inspect elements for severe wear or damage.	Scheduled Inspection				x						x				
BOP Stack	Shear Ram		If equipped with blind shear rams, inspect the seal(s) on the shear ram for wear, cracking, and excessive hardness by comparison with new seal(s). Replace the seal(s) if necessary. Inspect the shear blades for wear and damage. Replace if necessary.	Planned Maintenance									x				x	Rig Move
BOP Stack	Shear Ram		NDT shear ram blocks, blades and blade retaining bolts	Planned Maintenance											x			If any pipe has been sheared
BOP Stack	Shear Ram		When changing the shear ram lateral 'T' seal carry out an inspection of upper blade retaining socket head cap screws. Check cap screws for stretch and cracks. Install new socket head cap screws if any defects are found.	Scheduled Inspection														Rig Move
BOP Stack			Pressure test poppets	Scheduled Test											x			
BOP Stack	Choke & Kill		Grease valve body	Planned Maintenance														Keep adequately greased
BOP Stack	Choke & Kill		Flush valve with water	Planned Maintenance									X					After cementing jobs
BOP Stack	Choke & Kill		Pressure test	Scheduled Test													In conjunction with testing of preventers on BOP Stack	
BOP Stack	Choke & Kill		Check Stem Seals, Tail Rod Seals and Seat Seals for Leakage	Scheduled Test													In conjunction with testing	

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
																	of preventers on BOP Stack	
BOP Stack	Choke & Kill		Test Piston Seals	Scheduled Test													In conjunction with testing of preventers on BOP Stack	
BOP Stack	Choke & Kill		Flush C&K Lines	Planned Maintenance	x												Each Tour, 2x Daily	
BOP Stack	Choke & Kill		Prior to unlatching the BOP from the wellhead, open all choke and kill and annular bleed valves, and flush through the choke and kill lines with water.	Planned Maintenance									X					
BOP Stack	Choke & Kill		Flush valve with water	Planned Maintenance									X					After cementing jobs
BOP Stack	Choke & Kill		Lubricate the valve cavities with the manufacturers recommended lubricant and in accordance with the manufacturer's procedure.	Planned Maintenance									X					
BOP Stack	Choke & Kill		Where fitted, check the "failsafe" accumulator nitrogen pre charge, and adjust for water depth.	Planned Maintenance									X					
BOP Stack	Choke & Kill		Choke/Kill Female Stab Assemblies - Inspect, clean & lubricate	Planned Maintenance										x				
BOP Stack	Choke and Kill	Pipes/Hoses/Tubing	Visually inspect hoses, wires, and fittings. Repair or replace as required.	Scheduled Inspection									X				x	

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	Connector	Choke & Kill Stabs	Choke/Kill Female Stab Assemblies - Check polypak inserts for wear	Scheduled Inspection											x			
BOP Stack	Connectors	LMRP Connector	LMRP Connector should be function tested under controlled conditions in the BOP set back area or other suitable location.	Scheduled Test		x												
BOP Stack	Connectors	Control Pod Gripper Assembly	Inspect locking dogs and pack with grease and inspect and grease shear pin and hub and pack with grease	Scheduled Inspections									X					
BOP Stack	Connectors	Control Pod Gripper Assembly	Pressure test	Scheduled Test											x			
BOP Stack	Connectors	Control Pod Gripper Assembly	Replace seal and springs on primary assembly, and replace seals on the secondary cylinder	Planned Maintenance												3 years		
BOP Stack	Connectors		Measure the clearance between the dogs and the upper body or the dogs and the upper body wear plate if fitted using a feeler gauge. (API RP53 18.2.1) If the clearances recorded with a feeler gauge are not within the above minimum and maximum range, remove the dogs and confirm the clearances. Also check the dog springs for overall length and damage. Replace as necessary. Check the upper body to lower body cap screw torque and the cylinder head to lower body cap	Scheduled Inspection								x						

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			screw torque.															
BOP Stack	Connectors		Pressure test the operating chambers to maximum working pressure. Chart record the tests.	Scheduled Test								x						
BOP Stack	Connectors		Pressure test the ring gasket retaining circuit, if applicable. Chart record the tests.	Scheduled Test								x						
BOP Stack	Connectors		Perform low pressure unlock test, as per the manufacturers specifications.	Scheduled Test								x						
BOP Stack	Connectors		On the test stump, measure and record unlatch to latch indicator rod travel.	Scheduled Test								x						
BOP Stack	Connectors		• Flush all accessible external and internal surfaces with fresh water • remove and release the VX ring gasket from the connector • Clean and visually inspect the VX ring gasket and the mating seal surface in the connector. • Lightly grease the VX ring gasket and install in the connector to protect the VX seal surface. • Lubricate the connector as directed	Planned Maintenance									x					

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
BOP Stack	Connectors		While the lower body is extended, use water to flush out the exposed chamber between the 'OD' of the upper body and the inside diameter (ID) of the retracting cylinder. Once complete, purge the chamber with mixed BOP fluid.	Planned Maintenance									x					
BOP Stack	Connectors		Perform a visual inspection of the inside diameter and seal grooves in the lower body to see if there is any sign of mechanical damage, corrosion and or pitting. Polish the inside diameter and seal grooves with emery paper to remove any sharp edges and apply a light coating of grease prior to installing new seals	Scheduled Inspection									x					
BOP Stack	Connectors		Pressure test the hydraulic operating system (i.e., extend and retract) to the maximum operating pressure. All tests are to be chart recorded.	Scheduled Test									x			2 years		
BOP Stack	Connectors		• Once testing is complete, record the minimum extend and retract operating pressure to overcome the resistance of the snap ring in the 'ID' of the retract piston, i.e., only required if the snap ring is installed. • Wash the connector male stabs on the lower BOP with water. • Inspect the pin profile and seal surface for any signs of mechanical damage, corrosion and or pitting. Polish the 'OD' of the pin to remove and sharp edges and apply a light coating of grease. • Once the LMRP is installed, function test connectors, i.e.	Scheduled Test									x			Function & Pressure tests are done also at 2 years.		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			extend and retract, to confirm proper operation and alignment. • Record the initial unlock pressure of riser connector. • Wash the connector through bore with water, before landing on the test stump. (API RP 53 18.10.1) • Inspect the latching profile of the dog segments for mechanical damage. Ensure the dogs move freely and are not jammed between the upper and lower wear plates. If at this time the dogs have to be removed then the dog springs should be checked for damage, overall length and replaced if required. (API RP 53 18.10.1) • Measure the clearance between the dogs and the upper body or the dogs and the upper body wear plate if fitted using a feeler gauge. • Inspect the hydrate seal, where fitted and replace if required. (API RP 53 18.10.1) • Inspect the through bore for key seating damage. (API RP 53 18.10.1) • Check the gasket retainer pins and nudge pins if installed, for damage and function / pressure test to max operating pressure. Consult operations & maintenance manual for max recommended operating pressure and chart record all tests. • Lubricate the connector as per the manufacturer's recommendations.																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			• Pressure test the hydraulic operating chambers (primary lock, secondary lock, primary un-lock and secondary un-lock) to max operating pressure. All tests are to be chart recorded. (API RP 53 18.3.2.4) • Perform minimum unlock pressure test (i.e., primary un-lock only) once pressure testing is complete and record minimum un-lock pressure. • Install new gasket prior to running BOP.															
BOP Stack	Connectors	Riser Connector	Riser Adapter - Inspect, clean & Lubricate	Scheduled Inspection										x				
BOP Stack	Connectors	Well Head	Stack (wellhead) Connector - Inspect & Clean	Scheduled Inspection										x				x
BOP Stack	Connectors		Clamp Assemblies - Inspect, clean and lubricate	Scheduled Inspection										x				
BOP Stack	Connectors		Choke/Kill Female Stab Assemblies - Inspect, clean & lubricate	Planned Maintenance										x				
BOP Stack	Connectors		Choke/Kill Female Stab Assemblies - Check polypak inserts for wear	Scheduled Inspection											x			
BOP Stack	Connectors		Mandrel - Inspect and clean	Scheduled Inspection										x				
BOP Stack			Guideposts - Inspect, clean and grease	Scheduled Inspection										x				
BOP Stack	Connectors		Wash the connector through bore with water, before landing on the test stump.	Planned Maintenance														Rig Move
BOP Stack	Connectors		Remove the well head gasket, and clean and inspect ring groove.	Scheduled Inspection									x					Rig Move
BOP Stack	Connectors		Inspect the latching profile of the dog segments for mechanical damage. Ensure the dogs move freely and are not jammed between the upper and lower wear plates. If at this time the dogs have to be removed then the	Scheduled Inspection														Rig Move

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			dog springs should be checked for overall length and damage. Replace as necessary.															
BOP Stack	Connectors		Inspect the hydrate seal, where fitted.	Scheduled Inspection														Rig Move
BOP Stack	Connectors		Inspect the through bore for key seating damage.	Scheduled Inspection														Rig Move
BOP Stack	Connectors		Check the gasket retainer pins for damage and function test.	Scheduled Test														Rig Move
BOP Stack	Connectors		Lubricate the connector as per the manufacturer's recommendations.	Planned Maintenance														Rig Move
BOP Stack	Connectors		• Disassemble connector • Perform OEM inspection • Perform complete dimensional inspection. • Perform a MPI inspection on the dog ring segments, cam ring, connecting rods, operating pistons, high stress areas and fasteners. • Renew / rework all worn parts and seals. On completion of assembly, measure the dog ring to upper body wear plate gap. (API RP 53 18.10.3) • Pressure test the well bore to low pressure and to maximum working pressure. Chart record all tests. (API RP 53 18.3.2.2) • Clean and inspect the mating component (i.e. flange or hub connection) gasket prep for wear, pitting or mechanical damage. Place a new ring gasket in the prep and check for proper fitment. • Lubricate all stud and nut threads with an average coefficient of friction 0.064. • Lubricate the gasket prep with	Planned Maintenance												2 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			light oil, place the new ring gasket in the groove and install the connector. • Torque all nuts using the three level torque sequences to the required torque for the size of the stud and the coefficient of the lubricant used. • Function test connector • Stump test the connector															
BOP Stack	Connectors		• Perform OEM inspection. A thorough visual examination should be performed on the male stabs at this time and if visual condition dictates, (i.e. mechanical damage and or corrosion and pitting, etc.) these should be removed and included in the scope of work for inspection and repair. • Perform complete visual and dimensional inspection, of all the components including the flange connections on the upper body assembly, connector male stab and the API-BX-154 gasket preps. • Perform a MPI inspection on the high stress areas and fasteners. • Perform dye-pen inspection on all the seal surfaces, seal grooves and BX-154 gasket prep which are clad with corrosion resistant alloys.	Scheduled Inspection												2 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			• Compile the scope of work as confirmed by the inspection, complete repairs as per OEM requirements and assemble connector. • Pressure test the well bore to low pressure and to maximum working pressure and all tests are to be chart recorded. • Record the minimum extend and retract operating pressure to overcome the resistance of the snap ring in the 'ID' of the retract piston, i.e., only required if the snap ring is installed. • Lubricate all stud and nut threads with an average coefficient of friction 0.064. • Lubricate the gasket prep with light oil, place the new ring gasket in the groove and install the connector and male stab if it has been removed / replaced for inspection / repair.															

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Stack	Connectors		• Completely disassemble the connector and thoroughly clean all component parts. Remove and discard all seals • Visually inspect each component part for mechanical damage • Visually inspect the cylinder bores for pitting and corrosion, especially the areas of the cylinder liner and cylinder head seals. • Visually inspect all internal components for damage, scoring, corrosion, and pitting • Dimensionally inspect the upper and lower bodies, and all internal components; cylinder heads, pistons, cam ring, dog ring, end plates, wear rings, cylinder liners, retainer rods, and indicator rods. • Gage all primary load carrying fastener threads, male and female. • Using LP, inspect all seal grooves, piston rods, and cylinder bores with clad overlay • Using MT, examine all surfaces of the lower body, upper body, bolt shanks and heads, cylinder heads, dog ring, cam ring, and wear rings • Resurface the cam ring ID and dog ring OD • take hardness readings on the upper and lower bodies at three places, 120 degrees apart. • Reassemble the connector using all new rubber goods and test • Apply protective coatings to all external surfaces. • Record all data & serial numbers	Planned Maintenance												5 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			for future reference															
Stack	Connectors		• Disassemble the entire connector to its component parts. For tracking purposes, assign a job identification number to all components. (API RP53 18.10.3) • Inspect the areas outlined below and compare the actual values found, to the OEM specifications. Carry out any required repairs in accordance with the OEM specifications or other Field Support approved and qualified procedures. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the CX or BX ring groove on the upper body connection. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the VX or VXVT ring groove. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the upper body hub, flange or studded connection. NDT the welds in this area. (API RP53	Planned Maintenance												5 years		

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval: Drilling – Daily	Drilling – 7 Days	Drilling – 14 Days	Drilling – 30 Days	Upon Latching	Pre-Deployment and Between Wells – 60 Days	Pre-Deployment and Between Wells – 90 Days	Pre-Deployment and Between Wells – 180 Days	Pre-Deployment and Between Wells – Between Wells	Pre-Deployment and Between Wells – Each Trip	Major Overhaul – Annually	Major Overhaul – Multiyear	Miscellaneous – As Required	Miscellaneous – As Needed
			18.10.3) • Visually, dimensionally and NDT inspect the upper body connection threaded fasteners. (API RP53 18.10.3) • Take upper body & lower body hardness readings, as per the OEM recommendations. (API RP53 18.10.3) • Visually and dimensionally inspect the upper body through bore. (API RP53 18.10.3) • Visually and dimensionally inspect the upper body and lower body wear plates. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the cylinder heads. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the pistons, liners and cylinder end plates. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the connecting rods. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the lower body cylinder bores. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the cam ring. (API RP53 18.10.3) • Visually, dimensionally, and NDT inspect the dog ring. (API RP53 18.10.3) • Visually and dimensionally inspect the seal subs. (API RP53																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			18.10.3) • Visually and dimensionally inspect the gasket retainer pins. (API RP53 18.10.3) • Visually and dimensionally inspect the gasket retainer pin ports in the upper body. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the lower body threads. (API RP53 18.10.3) • Visually, dimensionally and NDT inspect the cylinder head to lower body and upper body to lower body cap screws. (API RP53 18.10.3 • Re assemble the connector with new seals, and dog ring springs. On completion of the re assembly, measure the dog ring to upper body gap. (API RP53 18.10.3) If the gap does not meet the correct specification for the connector, the upper and lower body wear rings may have to be machined or replaced. For studded top connectors, the dog ring gap should be checked with the connector torqued to the test flange. Pressure test the primary lock, primary unlock and secondary unlock chambers to maximum working pressure, 3,000psi. Chart record the tests. • Pressure test the well bore to low pressure and to maximum working pressure. Chart record the																

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
			tests. (API RP53 18.13.4) Note: If machining or weld and heat treatment repairs have been carried out, pressure test the body to the OEM recommended test pressure. A back drive test should also be performed after any major repairs. • Seal all ports and protect all sealing areas and paint															
Stack	Connectors		Perform Annual Maintenance Tasks	Planned Maintenance												5 years		
Stack	Connectors		• Disassemble female assembly. (API RP53 18.10.3) • Clean all components and inspect for damage to sealing areas and condition of coatings. (API RP53 18.10.3) • Inspect the area where the snap ring locks when in the retracted position for damage or wear. (API RP53 18.10.3) • Inspect the ring groove on the upper body. (API RP53 18.10.3) • NDT lower body and upper body (API RP53 18.10.3) • Re assemble using all new seals. (API RP53 18.10.3)	Planned Maintenance												5 years		
Stack	General	Frame	Clean the exterior of the stack with water	Planned Maintenance									x				x	
Stack	General	Frame	Check fastener security for all flanges, joints, and other fasteners on the LMRP and BOP Stack for proper type, size, condition and tightness.	Scheduled Inspection							x				x			

Table B-4: BOP Stack MIT Activities (cont'd)

BOP System	Subsystem	Component	MIT Activity	MIT Activity Type	Maintenance Activity Interval													
					Drilling				Upon Latching	Pre-Deployment and Between Wells					Major Overhaul		Miscellaneous	
					Daily	7 Days	14 Days	30 Days		60 Days	90 Days	180 Days	Between Wells	Each Trip	Annually	Multiyear	As Required	As Needed
Stack	General	Frame	Inspect all BOP guidance system framework components, connections and fasteners for security and condition.	Scheduled Inspection							x							
Stack	General	Frame	MPI all lifting points on LMRP.	Scheduled Inspection									x			5 years		
Stack	General	Frame	MPI all load bearing welds on stack frame. Repair any defective welds.	Scheduled Inspection												5 years		
Stack	Flex joint & Connectors	ERA & HPHT	Calibrate all the BOP transducers	Scheduled Test												2 years		

APPENDIX C – MIT MANAGEMENT SYSTEM SURVEY QUESTIONS

DEMOGRAPHICS

For which type of company do you work? *

- Drilling Contractor
- BOP Manufacturer

Which BOP manufacturer is most used on your companies deepwater rigs? *

- Cameron
- GE/Hydril
- NOV

To what is your job function most related? *

- BOP Maintenance
- BOP Operations
- BOP Technical Support
- Rig Management

What is your job role? *

- BOP Maintainer
- BOP Maintenance Supervisor
- Maintenance Planner
- Maintenance Scheduler
- Other Maintenance Support Personnel
- Rig Operations Leader
- Rig Operations Supervisor
- Reliability and Maintenance Engineer
- BOP Technical Expert
- Rig Manager
- Maintenance Manager/Director
- BOP Engineering Manager/Director
- Operations Manager
- Other

How many years of industrial experience? *

- 1 to 5 years
- 5 to 10 years
- 10 to 20 years
- More than 20 years

How many years of offshore experience? *

- Less than 1 year
- 1 to 5 years
- 5 to 10 years
- 10 to 20 years
- More than 20 years

How many years of in your current position? *

- Less than 1 year
- 1 to 5 years
- 5 to 10 years
- 10 to 20 years
- More than 20 years

INTERMEDIATE QUESTION TO DETERMINE VERSION

Where do you spend the majority of your time? *

- On a rig or the shop floor
- In the office

MANAGER VERSION

Check the most descriptive or most typical answer unless otherwise noted

If you are being asked to participate in this survey, it is because your company is participating in this study. As part of the study, all information sources will be maintained confidential and company-specific results will not be provided to BSEE.

How would you describe the parts replacement philosophy for Subsea equipment? *

- ☐ Upon failure
- ☐ On a set schedule either based on calendar or operational time
- ☐ Performed when equipment is not being used, even before typical service interval
- ☐ Based on the condition of equipment determined during regular inspections/test

How would you describe the parts replacement philosophy for Surface equipment? Upon failure *

- ☐ Upon failure
- ☐ On a set schedule either based on calendar or operational time
- ☐ Performed when equipment is not being used, even before typical service interval
- ☐ Based on the condition of equipment determined during regular inspections/test

How would you best describe the method to determine preventive maintenance periodicity? *

- ☐ Set based on original equipment manufacturer recommendation
- ☐ Informed by original equipment manufacturer, but adjusted based on our corporate experience with the same or similar equipment
- ☐ Based on reliability, availability, maintainability, RAM techniques and equipment criticality

Most part maintenance intervals are based on *

- ☐ Calendar time
- ☐ Operational time
- ☐ Part condition

Once a preventive maintenance frequency is set, it is *

- ☐ Never changed
- ☐ Only changed when designs change
- ☐ Revisited on a regular basis and adjusted based on equipment history
- ☐ Don’t know

Procedures are in place to note trends in equipment condition and failures? *

- Yes
- No

Which BOP failures are identified and documented? *

- All BOP failures, including minor failures
- Only BOP failures interrupting operations or discovered during a test or inspection
- Only BOP failures resulting in significant downtime or safety issues
- Only BOP failures which must be reported to management
- Only BOP failures which must be reported to a regulatory agency

When a BOP failure is identified, how is the failure documented? *

- No formal documentation required
- Enter in the rig shift/downtime log
- Initiate a work order
- Enter in dedicated failure tracking system

When are BOP failures formally investigated? *

- Not routinely investigated
- Only when BOP failure involves a safety incident or major downtime
- Repeat failure of the BOP component within a year
- A single failure or trending of repeat BOP failures meet set criteria
- All BOP failures are investigated

**Which tools are used during a formal BOP failure investigation? ***Check all that apply:

- Multi-discipline team
- Data gathering
- Failure analysis/testing (e.g., lab testing of failed components)
- Structured root cause analysis (RCA)/root cause failure analysis (RCFA) methods
- RCA/RCFA software

**When formal teams are formed to investigate a BOP failure, personnel from which departments are involved? ***Check all that apply:

- Operations
- Maintenance
- Engineering

- Safety
- BOP Manufacturer
- Do not know

What are typical outcomes of formal investigations of BOP failures? *Check all that apply:

- Changes in preventive maintenance activities or frequency
- Change in inspection/test activities or frequency
- Update to maintenance procedures
- Use of reliability analysis (e.g., RCM) to determine proper maintenance strategy
- Updates to maintenance management system
- None of the above

What level of corrective actions is typically identified? *Check all that apply:

- Basic causes correction (i.e., fix the problem)
- Specific equipment item improvements (e.g., increase maintenance, change design, operation)
- Personnel performance improvements (e.g., more training, better procedures)
- Similar equipment item improvements (e.g., increase maintenance, change design, operation)
- Management system changes (e.g., corrections to PM program

Which steps are taken to ensure corrective/preventive actions are implemented and effective? *

- No specific follow-up steps taken
- Corrective/preventive actions entered into database and status report generated
- Corrective/preventive actions status reports routinely reviewed by management
- Corrective/preventive action key performance indicator (KPI) generated and monitored

Which type of a work order/maintenance work management process is used to manage BOP maintenance? *

- Not aware of process
- Informal process
- Formal process with procedure, but not followed
- Formal process with procedure that is working well

What is the primary means used to identify and communicate the BOP maintenance work to BOP maintainers? *

- Verbal communication from operations personnel

- Verbal communication from supervisor
- Rig shift/log books
- Paper work order
- Computer-based work order system

Who determines the priority of the BOP maintenance work performed? *

- Do not know
- Operations personnel determines what is worked on
- Supervisor determine what is worked on
- Maintenance schedule developed by maintenance and operations personnel

What percentage of BOP maintenance work performed is managed by work orders (or similar written document)? *

- Almost never, < 1%
- Rarely, 1 % to 10%
- Occasionally, 10% to 25%
- Often, 25% to 75%
- Frequently, 75% to 95%
- Always, >95%
- Do not know

How often is the BOP maintenance work planned? *(Planned means a planner has reviewed the job, ensured information and parts are available, and scheduled the work)

- Almost never, < 1%
- Rarely, 1 % to 10%
- Occasionally, 10% to 25%
- Often, 25% to 75%
- Frequently, 75% to 95%
- Always, >95%
- Do not know

Once work is completed, which information is typically documented? *

- Nothing
- Mark the work order as complete
- Record time required

- Record equipment is OK (for PM results)
- Record actual PM results (when requested)
- Materials and parts used
- Failure information (for repairs)
- Failure code (for repairs)

If a work order/work management procedure exists, which areas are included in this procedure? *Check all that apply:

- Not aware of a written procedure
- Work Identification
- Work Approval
- Planning and Scheduling
- Work Execution
- Work Documentation
- Work Order Closeout
- Provisions for Emergency Work

How is the performance of the BOP maintenance work process tracked? *Check all that apply:

- No formal tracking mechanism
- Work backlog routinely reviewed
- Work management key performance indicators established and monitored
- Periodic audits of BOP maintenance work performed

Is BOP maintenance managed via a computerized maintenance management system (CMMS)? *

- Yes
- No

If there is a CMMS, which functions are in use? Check all that apply: *Check all that apply:

- ☐ No CMMS in use
- ☐ Asset register
- ☐ Asset Criticality
- ☐ Work request
- ☐ Work order
- ☐ Work prioritization
- ☐ Planning
- ☐ Scheduling
- ☐ Preventive Maintenance (PM)
- ☐ Work Closeout
- ☐ PM optimization (PMO)
- ☐ Reliability analysis
- ☐ Failure tracking
- ☐ Stores Inventory
- ☐ Document Management
- ☐ Cost Accounting
- ☐ Stores Purchasing
- ☐ Parts procurement
- ☐ Do not know

If there is a CMMS, how years has it been in use? *

- ○ No CMMS in use
- ○ Less than 1 year
- ○ 1 to 2 years
- ○ Between 2 and 5 years
- ○ More than 5 years
- ○ Do not know

For which types of management activities is the CMMS used? Check all that apply *

- Maintenance cost management
- Regulatory Compliance management
- Crew Management/scheduling
- Stores Inventory Management
- Reliability Engineering analysis
- Key performance indictor generation and monitoring

Which types of written instructions do BOP maintainers have access when performing BOP maintenance? *

- No written instructions
- BOP operation & maintenance manuals
- Technical information and drawings
- Work order job descriptions
- Site-specific step-by-step repair procedures
- Site-specific step-by-step PM procedures

How do BOP maintainers obtain written information when performing BOP maintenance? *

- Provided on or with work order
- Available via electronic document library
- Maintained in paper files
- Must request information from supervisor or others
- No too little information is available

Which types of BOP maintenance activities written instructions are provided BOP maintainers? *

- No written instructions
- BOP operation & maintenance manuals
- Technical information and drawings
- Work order job descriptions
- Site-specific step-by-step repair procedures
- Site-specific step-by-step PM procedures

How does the company ensure BOP maintenance information is up to date? *

- [ ] No system in place
- [ ] Depends on individuals to update information as needed
- [ ] Document control standard requiring information to be maintained
- [ ] Formal document control system with roles and responsibilities

Which types of information is be included in/with a typical repair work order? *

- [ ] Little information other basic equipment information (e.g., tag no., location)
- [ ] Task description
- [ ] Step-by-step task instructions
- [ ] References to other standard maintenance procedures or information (e.g., OEM manuals)
- [ ] Bill of material information

How are the accuracy of written instructions validated to be correct: *

- [ ] No validation or quality control process
- [ ] Instructions are written by knowledge personnel
- [ ] Instructions are provided by the OEM
- [ ] Formal procedure review and approval process
- [ ] Formal procedure review and approval process with field validation

What are the expectations on the use of written instructions? *

- [ ] No expectations
- [ ] A reference and informational tool
- [ ] Communication of safety information only
- [ ] General guideline on performing tasks
- [ ] Training tool only
- [ ] Step-by-step instructions on performing tasks

Which answer best describes typical use of written instructions when performing BOP maintenance? *

- Almost never
- Occasionally before beginning a task
- Usually before beginning a task
- Occasionally during the performance of a task
- Usually during the performance of a task
- Always during the performance of a task

Which type of training do BOP maintainers receive before working on a BOP? *Check all that apply:

- Informal training
- On-the-job training
- Formal training
- Previous work experience
- No training

When do maintainers receive training related to maintaining BOPs? *Check all that apply:

- No scheduled training
- Training when assigned to a maintenance position
- Regularly scheduled refresher training on BOP maintenance
- Training when major BOP configuration or operational changes occur
- Training when BOP maintenance or PM procedures change

On which of these topics do maintainers receive training? *Check all that apply:

- Safety policy and procedures
- Maintenance craft skills
- General BOP operations
- General BOP maintenance
- BOP repair procedures
- BOP PM procedures
- Other maintenance policies and procedures

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FIELD PERSONNEL VERSION

Check the most descriptive or most typical answer unless otherwise noted

If you are being asked to participate in this survey, it is because your company is participating in this study. As part of the study, all information sources will be maintained confidential and company-specific results will not be provided to BSEE.

Which BOP failures are identified and documented? *

- All BOP failures, including minor failures
- Only BOP failures interrupting operations or discovered during a test or inspection
- Only BOP failures resulting in significant downtime or safety issues
- Only BOP failures which must be reported to management
- Only BOP failures which must be reported to a regulatory agency

When you identify or are notified of a BOP failure, how is the failure documented? *

- No formal documentation required
- Enter in the rig shift/downtime log
- Initiate a work order
- Enter in dedicated failure tracking system

When a BOP failure occurs, which actions are taken to prevent repeat failures? *

- Fix BOP with no follow up
- Incident report completed for selected BOP failures
- Incident report completed for all BOP failures
- Formal investigation by a team if BOP failure is a safety or major downtime issue
- Formal investigation by team of all BOP failures

**When formal investigation teams are formed for a BOP failure, personnel from which of the following departments are involved? ***Check all that apply:

- Operations
- Maintenance
- Engineering
- Safety
- BOP Manufacturer
- Do not know

What type of information is communicated by BOP failure investigations? Check all that apply *Check all that apply:

- Description of the BOP failure
- Direct causes of the BOP failure
- Root causes of the BOP failure
- Corrective actions to prevent repeat BOP failure
- Preventive actions to prevent repeat BOP failure
- Status update on corrective actions taken

How are the results from BOP failure investigations typically communicated to you? *Check all that apply:

- E-mail
- Posted incident investigation report
- Normal shift communications
- Scheduled meetings (e.g., weekly toolbox meetings, safety meetings)
- Specially called communication sessions
- Not normally communicated

How would you describe the parts replacement philosophy for Subsea equipment? *

- Upon Subsea equipment failure
- On a set schedule either based on calendar or operational time
- Performed when Subsea equipment is not being used, even before typical service interval
- Based on the condition of Subsea equipment determined during regular inspections/test

How would you describe the parts replacement philosophy for Surface equipment? *

- Upon Surface equipment failure
- On a set schedule either based on calendar or operational time
- Performed when Surface equipment is not being used, even before typical service interval
- Based on the condition of Surface equipment determined during regular inspections/test

When active moving parts (e.g., actuators, rams, pumps) are rebuilt do you? *

- Assemble them by hand using only lifting equipment, when needed
- Rely on standard assembly tooling to rebuild some equipment
- Rely on standard assembly tooling to rebuild all equipment
- Rely on standard assembly tooling to rebuild critical equipment

What is done with parts when they are removed from service? *

- [ ] Visually inspected for wear/failure
- [ ] Dimensionally inspected for wear/failure
- [ ] NDT for wear/failure
- [ ] Only failed parts are further inspection
- [ ] Scrapped without inspection

Condition of parts removed from service is? *

- Recorded on paper maintenance forms
- Recorded and entered into CMMS
- Not Recorded

For which equipment is condition recorded? *

- For all equipment
- Only for critical equipment
- Only for equipment failures
- For no equipment

Most part maintenance intervals are based on? *

- Calendar time
- Operational time
- Part condition

Once a preventive maintenance frequency is set, it is? *

- Never changed
- Only changed when designs change
- Revisited on a regular basis and adjusted based on equipment history
- Don't Know

Are you aware of a work order/maintenance work management process? *

- Not aware of process
- Informal process
- Formal process with procedure, but not followed
- Formal process with procedure that is working well

What is the primary means used to identify and communicate the BOP maintenance work that you perform? *

- Verbal communication from operations personnel
- Verbal communication from supervisor
- Rig shift/log books
- Paper work order
- Computer-based work order system

Who determines the priority of the BOP maintenance work that you perform? *

- Do not know
- Operations personnel determines what is worked on
- Supervisor determines what is worked on
- Maintenance schedule developed by maintenance and operations personnel

What percentage of BOP maintenance work that you perform is managed by work orders (or similar written document)?*

- Almost never, < 1%
- Rarely, 1 % to 10%
- Occasionally, 10% to 25%
- Often, 25% to 75%
- Frequently, 75% to 95%
- Always, >95%

**How often is the BOP maintenance work you perform planned? ***Planned means a planner has reviewed the job, ensured information and parts are available, and scheduled the work

- Almost never, < 1%
- Rarely, 1 % to 10%
- Occasionally, 10% to 25%
- Often, 25% to 75%
- Frequently, 75% to 95%
- Always, >95%

Once work is completed, which information do you typically document? *

- Nothing
- Mark the work order as complete
- Record time required
- Record equipment is OK (for PM results)
- Record actual PM results (when requested)
- Materials and parts used
- Failure information (for repairs)
- Failure code (for repairs)

If there is a work order/work management procedure, which areas are included in this procedure? *Check all that apply:

- Not aware of a written procedure
- Work Identification
- Work Approval
- Planning and Scheduling
- Work Execution
- Work Documentation
- Work Order Closeout
- Provisions for Emergency Work

Is BOP maintenance managed via a computerized maintenance management system (CMMS)? *

- Yes
- No

If there is a CMMS, how many years has it been in use? *

- No CMMS in use
- Less than 1 year
- 1 to 2 years
- Between 2 and 5 years
- More than 5 years
- Do not know

Do you use the CMMS, if yes how often do you use the system? *

- Never use the system
- Once a month
- Once a week
- Once a day
- Multiple times each day

What types of activities, do you use the CMMS for? *Check all that apply:

- Enter work requests
- Review spare parts or bill of materials
- Order parts or materials from stores
- Other parts or materials inventory activities
- Retrieve/look up asset information
- Document task notes or results
- Close work orders (after completing work)
- Do not routinely use the CMMS

To which types of BOP maintenance activities written instructions do you have access? *Check all that apply:

- No written instructions
- BOP operation & maintenance manuals
- Technical information and drawings
- Work order job descriptions
- Site-specific step-by-step repair procedures
- Site-specific step-by-step PM procedures

How do you obtain written information when performing BOP maintenance? *Check all that apply:

- Provided on or with work order
- Available via electronic document library
- Maintained in paper files
- Must request information from supervisor or others
- No too little information is available

Which BOP maintenance activities are written instructions the most helpful? *Check all that apply:

- Written instructions are rarely helpful or needed for BOP maintenance
- Troubleshooting
- Repair tasks
- Scheduled tests
- Scheduled inspections
- Planned maintenance, such as rebuilding tasks)
- Lubrication tasks
- Regulatory-required tests

How are written instructions used when performing BOP maintenance? *

- Not used or needed
- As a reference during the task
- As a guideline for performing the task
- As a step-by-step procedure

Which type of information is typically provided in a maintenance work instruction? *Check all that apply:

- Little information other than basic equipment information (e.g., tag no., location)
- Task description
- Step-by-step task instructions
- References to other standard maintenance procedures or information (e.g., OEM manuals)
- Bill of material information

How helpful is the information provided in typical maintenance work instructions in properly completing the task? *

- No or little work order information needed to complete the task
- Provides little information needed to complete the task
- Provides sufficient information with references to other information
- Provides all needed details

Which answer best describes typical use of written instructions when performing BOP maintenance? *

- Almost never
- Occasionally before beginning a task
- Usually before beginning a task
- Occasionally during the performance of a task
- Usually during the performance of a task
- Always during the performance of a task

In general, what is the quality of the written instructions? *

- Poor
- Need work (many errors or missing information)
- Fair (some significant errors, by mostly correct)
- Good (95+% correct)
- Excellent (accurate and up to date)

Which type of training did you as a BOP maintainer receive before working on a BOP? *Check all that apply:

- Informal training
- On-the-job training
- Formal training
- Previous work experience
- No training
- Does not apply

How much initial training did you receive relative to BOP maintenance? *

- Less than a shift
- Between one to two shifts
- One week
- Two to four weeks
- More than one month

**How was your understanding of BOP maintenance training topics verified? ***Check all that apply:

- [ ] No verification
- [ ] Written test
- [ ] Informal on-the-job observation
- [ ] Formal on-the-job documented evaluation
- [ ] Hands-on practical evaluation

When do you, as a maintainer, receive training related to maintaining BOPs? *

- ( ) No scheduled training
- ( ) Training when assigned to a maintenance position
- ( ) Regularly scheduled refresher training on BOP maintenance
- ( ) Training when major BOP configuration or operational changes occur
- ( ) Training when BOP maintenance or PM procedures change
- ( ) Does not apply

How often do you receive training related to BOP maintenance? *

- ( ) Very frequently
- ( ) Monthly
- ( ) Quarterly
- ( ) Annually
- ( ) As needed when there is a major change or problems
- ( ) Rarely

How much on-going training do you receive each year relative to BOP maintenance? *

- ( ) No periodic training provided
- ( ) 1 to 4 hours
- ( ) 4 to 8 hours
- ( ) 8 to 16 hours
- ( ) 20 to 40 hours
- ( ) More than 40 hours

**On which of these topics have you as a maintainer received training? ***Check all that apply:

- ☐ Safety policy and procedures
- ☐ Maintenance craft skills
- ☐ General BOP operations
- ☐ General BOP maintenance
- ☐ BOP repair procedures
- ☐ BOP PM procedures
- ☐ Other maintenance policies and procedures
- ☐ Does not apply

How would you rate the BOP maintenance training program? *

- ○ What program?
- ○ Needs major improvements
- ○ Barely adequate
- ○ Meets the my need
- ○ Best training I have had